Electrical News
Generation, Transmission and Application of Electricity

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A Municipal Electrical Association

At the recent annual meeting of the Ontario Municipal Electrical Association the advisability of broadening the scope of the association was discussed. Up to the present time the object of this association has been the discussion of matters of policy rather than of technical practice and the name electrical has been applicable only because it is an organization including municipalities who are distributing electric energy. The need of an association in which the engineers and operating men in the employment of municipalities could meet together and discuss matters of a technical engineering nature has long been keenly felt and at the recent convention the sentiment was unanimously in favor of establishing the present association on a much broader basis.

It may not be out of place to outline briefly here the situation in Canada with regard to electrical associations as existing in the past. The Canadian Electrical Association was the only association of its kind for many years and was formed for the purpose of discussing matters of common interest to private electric companies, both engineering and commercial problems being considered. A few years ago the National Electric Light Association of the United States began branching out into Canada and a number of local sections were formed, as for example in Hamilton, Toronto, Ottawa, Vancouver, etc., composed chiefly of the staff of the private company operating in any particular city, but connected in no way with the Canadian Electrical Association. Some two years ago, at the annual meeting of this latter association, it was decided to affiliate with the N. E. L. A. and the local branches, scattered throughout Canada, consented to come into the C. E. A. and be known as local branches of the C. E. A. instead of local branches of the N. E. L. A. This arrangement is still in existence.

With the growth of municipal ownership of electric public utilities in Canada the need of an association where municipal officers and engineers can meet to discuss electrical matters has been fully recognized. Attempts have been made on more than one occasion to induce the C. E. A. to open its doors to municipal men, but without success. At the last annual convention of the C. E. A., held in Toronto last June, there was a strong and very evident feeling not only on the part of municipal men who were in attendance but the opinion was also expressed by delegates from private companies that municipalities should be included in the association. The opposition to this move, however, was sufficiently strong to prevent any change being made and the municipal men reluctantly concluded that there was no chance of the matter being reconsidered.

The inevitable result is seen in the resolution carried unanimously at the recent municipal convention appointing a committee to draft a constitution along lines somewhat similar to the C. E. A. so that matters of a technical nature may be discussed with profit to the operating engineers in the employment of the different Ontario municipalities. This association for the present is to be known as an Ontario association, but we have no doubt that ultimately its scope will be extended to include the whole Dominion, as the need for such an association is almost as great in the other parts of Canada as in Ontario. This is particularly true of the western provinces where municipal plants far outweigh in numbers the plants controlled by private enterprise.

It is plain to us that this association is the natural and only possible result of the conditions existing in Canada at the present time. The municipalities were evidently greatly disappointed at the continued refusal of the C. E. A. to allow them to enter its ranks. The problems of common interest in the electrical field are so numerous, as compared with the points at issue between the private companies and the municipal plants, as to entirely outweigh any objections to a common association, and we believe the C. E. A. has made a diplomatic error in persisting to hold the municipalities at arm's length. Speaking prophetically, we are convinced that the ultimate outcome of the present condition will be the amalgamation of all existent associations into one powerful Dominion organization with sections for technical, commercial, etc., discussions, and provincial branches for the transaction of business of a more local nature. It is inconceivable that two associations each having as its object the advancement of the electrical trade in Canada should exist side by side in an antagonistic attitude. It is quite possible that this latest municipal move is the first step in the right direction and that it will have a far-reaching influence in coordinating the opposing interests into one powerful, harmonious, national organization. Such an association would be the means of bringing the opposing sides together on common and friendly ground, where it would soon be discovered that neither is as bad as the other paints him, where actual differences of opinion would have a chance to undergo readjustment and where the general tendency would be towards a better and more cooperative feeling for the good of the electrical industry at large.

Getting the Figures Down

In spite of the fact that a large amount of construction work is imminent in the Ontario hydro-electric system, including stringing a second transmission line from Dundas to London to St. Thomas and the probability of an extra tower line connecting Niagara Falls with Dundas, the Ontario Hydro-electric Power Commission have been able to reduce the power rates to a number of cities. Recommendations have also been sent out to a number of municipalities reducing the price of power and light to the consumer. Though these recommendations are in the form of suggestions, it is of course understood that the commission have the power to

enforce any rates they may set. However, each municipality is by this means given the chance to express its own point of view and if it can convince the commission that present rates are low enough and that either as a result of necessary extensions or for other causes these rates should not be reduced, the commission will not enforce its recommendation.

The following reductions have been made by the commission as mentioned above, to twelve of the municipalities interested:—

	Old price per h.p.	New price per h.p.
Hamilton	$16.00	$15.00
Dundas	16.00	15.00
Caledonia	29.10	24.00
London	24.00	23.00
Guelph	22.00	21.00
Preston	21.50	21.00
Galt	22.00	21.50
Waterloo	23.50	22.50
Berlin	22.50	21.50
Baden	37.00	32.00
St. Thomas	29.00	28.00
Port Credit	31.00	28.00

The conditions in Ottawa also favor a considerable reduction in the price to the consumer as the commission have been able to close a contract with the Ottawa & Hull Electric Company for the supply of 20,000 h.p. for a period of 35 years at a somewhat reduced rate. Up to the present time the commission has been paying this company $15 per h.p. but the following scale will be enforced after the beginning of the year:—Up to 5,000 h.p., $14; 5,000 to 8,000, $13.50; 8,000 to 10,000, $13; 10,000 to 12,000, $12.50; 12,000 to 14,000, $12; 14,000 to 16,000, $11.50; 16,000 to 18,000, $11. This power is purchased on a twenty minute peak load monthly basis and the commission is required to take up to 75 per cent. of the power held in reserve under the contract. This is an arrangement entirely similar to that existing with the Ontario Power Company, of Niagara Falls.

Electrical Inspection Appointments

The city of London is the most recent addition to the ranks of those municipalities which believe in having their electric installations properly inspected. A very capable officer in the person of Mr. W. B. Legate has just been appointed inspector and by all accounts he is going to be backed enthusiastically by the private and municipal systems and by the electrical contractors. The spirit of co-operation was very evident on the occasion of a recent address by Mr. H. F. Strickland, chief electrical inspector of the Hydro-electric Commission of Ontario, who explained at length the system of inspection the commission have decided to inaugurate and the advantages to be gained by it. Under the London by-law it is now necessary to get a permit to install electric wiring just as, in the past, a building permit has been required, and the officers of the law have authority to stop any work being carried on without such permit. Approval of the installation work is further necessary before the building will be connected up to any source of supply. There is no doubt that these requirements will both tend to ensure against electric work being installed either according to unsafe specifications or by incompetent contractors. Poor work in the past may be attributed either to incompetence or dishonesty. The former can now be eliminated by the refusal of a permit; the latter will be held in check by the fact of the final inspection.

It is gratifying to note the ready response of the various municipalities to the Commission's attempts to remove the dangerous conditions existing at many points in Ontario. It is not clear, however, that those municipalities which are most in need of the medicine are the most eager to accept it. Up to the present time inspectors have been appointed in London, Ottawa, Berlin, Waterloo, Tillsonburg, Stratford, Port Arthur, Fort William, Welland, Goderich and Clinton., and by-laws have been passed similar to that of the city of London, but it is noticeable that one or two of the larger cities, where conditions are far from satisfactory, are very tardy in taking action. This is perhaps largely due to competitive conditions existent in those cities, but since more stringent regulations would affect all about equally this excuse alone would not appear to carry sufficient weight to cause further delay. The only other evident excuse is that the cost of some of the installations might possibly be greater, under independent inspection, than at present, on account of more stringent requirements. The placing of safety to life and property against a little added expenditure is surely bad business, however, and ought to be, in this electrical age, a practice only of the past.

Good Advertising

Much can be done by the central station owner or manager to advertise his electric wares and it is just possible that the average central station man does not appreciate fully that his customers have very little information regarding electric household appliances and the value of their more general use. A good deal has been written and said about the maintainance of demonstration rooms and a number of companies and municipalities are taking this matter up actively and, we understand, with very excellent results. Among this number is the Trenton Electric & Water Company of Trenton, Ont., who recently opened an electric shop where they give

The Trenton Electric and Water Co., Limited
invite you to attend a
Demonstration of Electric Cooking and Heating Devices
at
"The Electric Shop"
Dundas Street, Trenton
Tuesday, December Sixteenth
from two to nine p.m.
The showing of goods electrical will be unusually interesting, including
many new appliances that add greatly to the comfort
of a modern home or office
A. T. Hicks, Manager

demonstrations on electric cooking and heating devices. We reproduce herewith the invitation card which was widely distributed by the Trenton Company and is so nicely worded and so artistically printed that we should imagine anyone receiving an invitation would feel almost as if he had received a complimentary to a conversazione. It follows that there are very few who would decline to accept the invitation and the useful and educative results from the point of view both of the customer and the central station can be readily imagined.

The city of Winnipeg light and power department are building a 12,000 volt transmission line between their substation and the G. T. P. shops in Transcona. The town's interest in this matter, as well as others of an electrical nature, are taken care of by W. E. Skinner, Limited, their consulting engineers.

A Letter Regarding Electrocution

Winnipeg, Manitoba.

The Editor, Electrical News.

Hardly a week goes by but there is mention in the Daily Papers of the electrocution of some member of the electrical fraternity. Accidents are bound to occur, as no apparatus invented so far is absolutely fool proof; also to err is human, and no matter how careful one may be, there are times when familiarity breeds contempt, and the presence of continual danger is lost sight of. In looking at all branches of applied science, electrical engineering stands alone in the way of having least protection afforded for its workers. By-laws have been framed for the protection of buildings, apparatus, etc., but very little seems to have been done for the protection of those installing and handling electrical apparatus, and it is refreshing to note that various organizations throughout the country are taking up this side of the question with a view to preventing loss of life.

Certain statistics are available showing the actual loss of life by electrical workers throughout the country, as far as is known, but the following figures do not, of course, cover cases that are not on record, having occurred outside such precincts of jurisdiction where statistics are not easily obtainable.

From June, 1910, to May,1911, inclusive, there were 31 electrocutions, resulting fatally, throughout the Dominion.

From April, 1912, to April, 1913, inclusive, the Electrical Workers' Union had 66 members fatally shocked. This figure does not include electrocutions outside of the Union, and therefore, does little more than show the immense increase in the death list since 1910.

In October, 1913, five electrocutions with fatal results occurred, and the same number in November, 1913.

If protection were brought to the highest state of perfection a good many accidents would still result owing to actual carelessness on the part of individuals involved, as it is unfortunately the case that 90 per cent. of accidents in connection with the above subject are due to carelessness on the part of individuals, and just how far such individuals would be further protected by adequate protection in the way of legislation and by-laws, etc., is rather an unknown quantity.

Coming to the matter of the various methods of resuscitation, we must consider certain phases of the question that do not actually cover the word resuscitation itself, but rather more in the need of organization of centralized committees to skilfully and promptly apply the most advanced methods known to the medical and electrical profession. Of all cases of electrocution that have come to the writer's notice in the last few years, the majority of them appear to be of such a nature that, had proper methods of resuscitation been applied, the unfortunate victims would have been brought back to life. Also, it is a lamentable fact that a good many worthy gentlemen of the medical profession are so far not very well acquainted, owing to lack of experience, with just how far methods of resusciation should be prolonged before giving up all hope of bringing the victim back to life. There is no question in the writer's mind that 90 per cent. of the cases of shock, even though the victim may appear dead by all known tests of materia-medica, should not be given up for at least three or four hours, so as to give the victim every possible chance. The writer's experience of these matters, and reference to statistics, have prompted him to write this letter, which is being sent to the Press and also to the heads of the various universities. In the former case, it will give publicity to a vital subject, resulting in a more general knowledge of the matter in hand, and in the second case, the writer hopes that the principals of the various universities may see their way clear to embody in their curriculum of electrical engineering a thorough knowledge of the various methods of resuscitation from electric shock, as there is no question but that at least 50 per cent. of the present mortality due to electric shock could be avoided were every electrical worker thoroughly familiar with what to do in the case of a fellow worker being shocked.

As a suggestion of the best method of taking care of such cases mentioned above, the writer feels that it would involve no great hardship for all cities to form some central committee composed of good first aid men of the electrical profession and medical profession, at least some of which committee could always be gotten at from some central point by telephone or other means, in case of an accident occuring, so that if any worker were at any time badly shocked some center such as the central police station, the fire hall, the general hospital or power house, could be notified, and from there orders issued for two or three available members of the committee to immediately repair to the scene of the accident.

This letter is written in the hope that there will be a greater interest taken in this subject, and if publicity to same helps in any way to reduce the enormous loss of life apparent in this field of engineering, the writer's object will have been attained.

Charles F. Gray,
Mem. A.I.E.E.,
Assoc. Mem. I.E.E.

Striking Examples of Resuscitation

Dr. Chas. A. Lauffer, medical director of the Relief Department of the Westinghouse Electric & Manufacturing Company recently made some interesting statements regarding the resuscitation of victims of electric shock. Dr. Lauffer states that cases are on record where shocks received from 8,000 and 10,000 volt lines have not proved fatal and where patients have been declared dead by physicians and yet have been resuscitated by the prone pressure method of resuscitation. He says that because the prone pressure has no apparatus to sell it gets very little advertising and the general public has too little information of its value. The following extracts from a paper recently prepared by Dr. Lauffer are full of useful information.

"Men have received 8,000 and 10,000 volts—we personally know of one who received 11,000 volts—and recovered. Arc and static discharges from 240,000 volt conductors, and even higher voltages, are not necessarily fatal, if artificial respiration is resorted to at once, as the following actual instances will show:—

Case A—During July, 1913, a patient received 8,000 volts. He was unable to release himself from a live wire he had inadvertantly touched, and which was fastened to a switchboard. He had failed to trace its source, but started to unscrew the connection; his right hand touched the screw, his left hand held the bare wire, while the current went through his body. The left hand folded over the right breast, and in falling his right forearm and back came in contact with iron piping. He was badly burned in five places.

The comrade nearest him who saw him drop, took four steps to pick up a piece of wood, ran back the four steps and knocked the line out of his hand. The duration of the dangerous contact exceeded fifteen seconds.

It required fifteen minutes of rhythmic effort at artificial respiration to get him back to normal breathing. For a time he breathed as though every breath would be his last, his diaphragm being in tetanic contraction, but by increasing the elevation of the diaphragm at the rate of twelve times a minute, by the prone pressure method, this spasmodic type of respiration subsided, and normal breathing was restored. Mr. E. V. Saunders rescued him from the line, and he, to-

gether with Mr. C. W. Diehl have the honor of this resuscitation.

Case B—This accident occurred five years ago. The patient opened a live circuit and fell against a steel hose, receiving 10,000 volts, and the contact was of several seconds duration. He lost two fingers and carries ugly scars on his palm, wrist and back. His case presented a severe complication, edema of the lungs; fully two pints of bloodstained serum was expectorated, but he reacted to drugs and cracked ice, and his burns healed happily.

The honor of this rescue and resuscitation belongs to Mr. F. S. Peterkin, a man who has resuscitated six men without a failure. One hundred per cent of success is noble achievement; all of his cases were at high voltage, and of a serious type. Why this man's uninterrupted success? He gets busy at once, for every second is an hour when the action of a man's diaphragm is paralyzed. He works continuously at the artificial respiration; he does not stop to theorize about the fibrillating heart, or the probability of hemorrhage in the brain and spinal cord. A victim of electric shock, and other conditions requiring resuscitation, needs instant assistance in the way of artificial respiration; few persons are killed outright by electricity.

Case C—This man received 11,000 volts, yet was successfully resuscitated. His palms were so deeply burned that both hands were subsequently amputated.

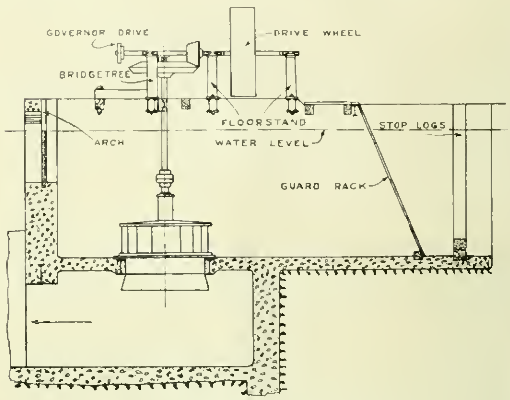
Cases are on record, moreover, where patients were declared dead by physicians, yet by the prone pressure method of artificial respiration have been resuscitated. But because prone pressure has no apparatus to sell, it has no publicity department and the general public is too little informed of these successes. There will always be need of manual methods, yet some of the mechanical devices should probably be endorsed. But until all cases are honestly reported, manual methods will not receive due publicity; the commercial interests back of the mechanical devices boost their apparatus, and disparage manual methods, notwithstanding the fact that manual methods are necessary to keep the patient alive until the apparatus can be brought to the scene. It is then customary to give such apparatus the entire credit for the resuscitation.

Small Private Plant in Inglewood

A neat hydro-electric plant was recently placed in operation by the Shale Products Company, Limited, of Inglewood, and we publish herewith a few of the more important details. The plant is situated on the Credit River, about three-quarters of a mile from the town and was planned by Chas. Barber & Sons, Meaford, who also supplied and installed all the hydraulic equipment. The turbine is a 70-inch, normal speed, vertical type wheel and power is transmitted through machine dressed, bevel gears to a jack shaft carried on substantial iron bridge-trees on which shaft a large drive wheel is installed. From this wheel the power is transmitted by belt to the generator. The exciter is belt-driven off the generator shaft.

View of interior—Shale Products Co's plant.

All the hydraulic construction work is of concrete, with steel reinforcement, and is designed for a working head of 12 feet under which condition the turbine develops a capacity of 185 h.p. The turbine is controlled by a size D Woodward compensating governor and the regulation is claimed to



Section through Shale Products Co.'s plant.

be such that a minimum of attention is required in operating the plant. The generator was installed by the Canadian Westinghouse Company, and supplies current direct to the transmission line at 2300 volts. The transmission line to the factory is No. 6 bare, hard-drawn copper wire.

The electrical installation at the consuming end consists of three 30-kw. transformers, one small lighting transformer, two large and three small motors. The three large transformers step the current down to 550 volts for driving small motors which are used to operate conveyors, a pump and a fan. The machinery driven by the two large motors is divided into two groups; the first group includes three dry pans and three 30-foot elevators; the second group includes a brick machine, two pug mills, a cutter table, tailings conveyor and clay feeder. Both the large motors operate at 2200 volts directly off the transmission line, the first having a capacity of 125 h.p. and the second a capacity of 150 h.p.

This company was organized in 1912 for the manufacture of high grade vitrified brick out of the Medina shales. The officers are Messrs. T. H. Graham, president, J. M. Scott and J. R. Scott, all of Inglewood.

First Meeting Toronto Section A. I. E. E.

The first regular meeting of the Toronto section of the A. I. E. E. was held in the engineers' club, 96 King St. West, on Friday evening, December 9. Mr. J. A. MacMurchy, of the Westinghouse Machine Company, Pittsburgh, Pa., gave an illustrated talk on steam turbines. An interesting feature of the lecture was a description of a 30,000 kw. unit recently manufactured by the Westinghouse Company and which has been shown to have an economy of about 12 pounds of steam per h.p. hour.

It is understood that the Board of Commissioners appointed to control the electrification of the London & Port Stanley Railway will be in a position to place orders for the necessary equipment in the near future. Mr. S. B. Storer will be engineer in charge of the work.

Pine River Plant Extensions

The Pine River Light & Power Company have recently added largely to their hydro-electric plant situated on the Pine River, a tributary of the Nottawasaga, some 22 miles from Orangeville, at which point the head office of the company is located. The Pine River Light & Power Company was incorporated to take over the business of the Dufferin Light & Power Company which had in turn taken over the lighting and power plants of Orangeville and Shelburne. The company now serve Orangeville, Shelburne and Horning's Mills and is making preparations to serve Dundalk and possibly Grand Valley and Arthur, the latter of which would require a 28-mile distribution line. The company maintain a steam auxiliary plant in Orangeville.

During the past summer a new dam has been completed which is 675 ft. in length, 60 ft. high, 300 ft. in width

New Pine River dam, forming 80 acre lake.

at the bottom and 25 ft. at the top. The dam is built of clay with a puddled clay core. The face of the dam is rip-rapped with stone and is strengthened by a retaining wall of stone 20 ft. high, 10 ft. wide at the base and 7 ft. at the top. The dam is sloped 2½ to 1 on one side and 2 to 1 on the other side. The lake formed has an area of 75 to 80 acres. A cement fore-bay fitted with iron racks leads the water into a wooden flume 1,600 ft. in length. This pipe is circular, 42 inches in diameter the staves being held together by iron bands placed 7 to 10 inches apart. The lower 350 ft. of the flume is of steel pipe. A stand pipe 26 ft. in height has been installed at the junction of the wooden and steel pipes

Power House and pipe line—Standpipe in the distance.

Interior showing one of the generators, etc.

to take care of water surges. The total fall obtainable is 139 ft. The power house is constructed of cement and measures 36 x 48. The turbine chamber is separate and divided into three sections, in two of which 300 h.p. units have been installed. The third unit will be put in as required, so that the plant will ultimately be capable of generating 900 h.p.

The turbines are the Jenckes snail steel type and each is direct-connected to a 175 kv.a. Westinghouse 2200 volt generator with belted exciter. Current is stepped up to 22,000 volts for transmission.

The president of the company is Mr. J. M. Kilbourn, Owen Sound; Mr. T. R. Huxtable is secretary and manager.

Western Canada Power Development Plans

Mr. R. F. Hayward, general manager of the Western Canada Power Company recently read a paper before the Vancouver Branch of the Canadian Society of Civil Engineers on the hydro-electric development of the Western Canada Power Company, Limited, at Stave Falls, B.C. A synopsis of Mr. Hayward's remarks follow:—

The paper, which was illustrated by a number of lantern slides, described the design and construction of the power plant which is now in operation at Stave Falls, gave a general outline of the proposed additional developments on the Stave River, which will ultimately bring the capacity of the plants to 120,000 horse power, and dealt very fully with the question of water supply and the most economical development that could be made under the physical conditions which obtain in the Stave Valley.

The existing plant is designed for four 13,000 h.p. units, two of which are now in operation, with two additional ones on order. The development consists of a heavy concrete intake dam about 60 feet high, which is to be raised in the course of the coming year another 20 feet; a sluice dam consisting of piers closed by removable stop logs; a reinforced concrete power house on a foundation excavated out of solid rock, and a tailrace about 1,500 feet long excavated to a depth of about 30 feet. The power house is now operating under 100 ft. head and, when the dam is completed to its full height, will operate under a maximum head of 120 feet.

From the tailrace of the existing plant to the mouth of the Stave River there is available for further development, a fall of 130 feet. Two plans of developing this fall are now under investigation; the first contemplates the whole development at one place and involves the construction of a dam 165 feet high in a rock gorge at the mouth of the river. The second plan provides for two power houses each operating under 65-ft. head, one to be built at the mouth of the river, the other about one mile below the existing plant at Stave Falls. On account of the great saving that can be made in

the cost of dams, the two low head plants will probably prove the most economical development.

Stave Lake lies to the north of the Fraser River about 35 miles east of Vancouver. The watershed, which is only partly explored, has an area of about 450 square miles. It is formed by the granite mountains of the Coast Range, which rise to elevations of over 8,000 feet, and carry perpetual snow. The river, from its source in a large glacier, to the mouth of the Fraser River, is about sixty miles. The lake has an area of about 12 square miles, and lies at an altitude of 230 feet above sea level. Three is a fall of only 14 feet in seven miles of the river from the foot of the lake to Stave Falls. There it drops about 80 feet and flows thence in a series of rapids to its tidal mouth at Ruskin on the Fraser River.

The annual rainfall, taken over a period of the last twenty years in the vicinity of Stave Falls, has averaged 77.5 inches with a minimum year of 50 inches, and a maximum year of 90 inches. The average precipitation over the drainage area is unknown, as Stave Falls is the only point at which a rain gauge has been established. Stream measurements have been taken continuously for nearly six years. The mean annual run-off of the river is approximately 4,000 cu. ft. per second, and the lowest mean annual run-off was 3,400 cu. ft. per second. The ratio of run-off to the precipitation as measured at Stave Falls is 1.6, which indicates that the average precipitation over the whole basin is probably twice the precipitation at Stave Falls.

The maximum flood discharge that has been measured in the natural state of the river is about 36,000 second feet, but if the controlling action of the lake were eliminated the actual maximum flood run-off would be nearly 60,000 c.f.s. and this is the amount which must be taken into account in calculating the design of spillways.

It is practicable to build a dam at Stave Falls to raise the water 40 feet above its low level, thus increasing the area of the lake for storage purposes from 12 to 24 square miles.

Mass curves of the run-off having been plotted for the past six years and the following series of curves has been computed to determine the most economical development that could be carried out, viz:

1. A curve showing mean flow available for varying height of dam.

2. A curve showing mean head available for varying height of dam.

3. A curve showing mean power available for varying height of dam.

4. A curve showing mean cost of increasing height of dams to store water 30, 35 and 40 feet above low lake level.

From these curves the maximum available power on a sixty per cent. load-factor with turbine efficiency of 83 per cent. is worked out as follows:

	h.p.
1. For dam to store water 30 feet above low level	52,000
2. For dam to store water 35 feet above low level	59,000
3. For dam to store water 40 feet above low level	64,000

The cost of increasing the dams above the 30 foot level worked out as follows:

From 30 to 35 ft. level	$20.00 per h.p.
From 35 to 40 ft. level	25.00 per h.p.

Beyond this limit the cost per h.p. increases very rapidly.

The power house was designed to operate under a maximum head of 120 feet, a minimum of 100 and a mean of about 110. It was laid out for four 13,000 h.p. units.

The turbines, which are horizontal type, double Francis wheels with central discharge, running at 225 revolutions, were built by Escher Wyss & Company, of Zurich, and the 9,000 kv.a. generators were built by the Canadian General Electric Company.

The intake dam is founded upon solid rock and is built of concrete, heavily reinforced at certain parts. There are four main intake gates of the radial type, each gate closing an opening 20 feet square under a maximum head of 45 feet.

Each penstock is 14 ft. 6 ins. in diameter, and about 150 feet long. The power house foundation is excavated out of solid rock, and the building is a heavily reinforced concrete structure.

Port Arthur's Fine Prospects

Mr. J. J. Hackney, Port Arthur Utilities Commissioner, presented a very interesting report at a recent meeting of the Board of Trade, in which he outlined the power situation in the city of Port Arthur. All public utilities in this city are municipally controlled, the power supplied being partly obtained from the Hydro-electric Power Commission of Ontario, who buy from the Kaministiquia Power Company, and partly from their own plant on Current River. Mr. Hackney's remarks in part follow:—

"The apparatus contained in our Current River plant consists of 1,560 h.p., A.c., and 270 h.p. d.c. equipment. With this equipment we are able to develop for five or six hours, 1,600 h.p., and in addition, a continuous load of from 500 to 700 h.p., or a combined load for a short time of 2200 h.p.

The municipal plant is tied in to the Hydro-electric Power Commission's sub-station, which is at present being enlarged to a capacity of approximately 10,000 h.p. Our present peak from this station is 2,100 h.p. The city's power load is at present approximately 7,000 h.p., as follows:

	h.p.
Electric light	1890
Street railway	1600
Government elevator	900
Dry dock	830
Water works	450
C. N. R. elevator	400
Street light	200
Stewart & Hewitson	250
With a number of smaller consumers	480
Total horse power	7000

This year, on the advice of the Hydro-electric Power Commission, we combined the power and electric light departments under the head "Electric Department." The gross revenue from this department for the year will be approximately $165,700, or a net revenue over and above all maintenance, interest and sinking fund charges, of $62,000. When we compare this with the past five years, it will give you as good an indication of the growth of the city, as the assessment. The comparison is as follows:

1909 net profit	$5,242.00
1910 net profit	11,301.00
1911 net profit	11,968.00
1912 net profit	42,688.00
1913 net profit	62,000.00

Bear in mind that the metered light rates have been lowered twice during the past two years, until now we have the lowest rate in existence in the Hydro belt, and good chances of a further reduction in the near future. We have at present 3,325 light consumers and 55 power consumers, 500 light services were installed this year, and 10 power consumers added. The total capital investment of the city in the Electric Department is $570,000.

Our contract with the Hydro Commission provides for 5,000 h.p., of which we are taking 2,100 h.p. This amount we are hoping to increase to 4,000 or 4,500 next year. Among some of the consumers we hope to get are the C. N. R. Coal Dock and the Davidson-Smith elevator and mill, and an increase in the water works of 600 h.p. When we in-

crease the amount taken from the Hydro to 4,000 h.p. we get a reduction of $1.00 per h.p.

Forseeing the rapid development in this department, early in the year, I recommended to the Council the advisability of requesting the Hydro-electric Commission to make a report on the development of Dog Lake. This was done, and surveyors have been working for several weeks on this development. With Dog Lake developed, we should be able to get high tension power delivered to the city at $9.00 to $10.00 as against $16.00 at the present. We should then be able to deliver to consumers, low tension power at about $15.00 to $16.00 per h.p., with a corresponding decrease in light to, say, two cents per kw.h.

Another matter in this department that is rapidly coming into use, is electrical cooking. We have supplied a number of electric ranges to citizens, that have given good satisfaction. This range can be supplied at $75.00, and will give satisfactory service to a family of five or six, for a monthly payment of $3.50. If this department is developed it will give a large revenue to the electrical department, also a very cheap fuel to consumers.

Early in the season we commenced the sale of tungsten lamps, and we have been able to give a guaranteed lamp to the consumers for 40 cents for 25 watt and 40 watt lamps, and 45 cents for 60 watts. We have sold during 1913, 11,000 lamps.

Telephone Department

While I am on the subject of utilities, I may be pardoned if I mention the Telephone Department, which is also doing very well. We have at present 2,700 subscribers, an increase of 400 during the year. The gross revenue of this department for this year will be approximately $46,000, and will show a nice net profit, even with the lowest telephone rates in the Dominion.

Street Lighting

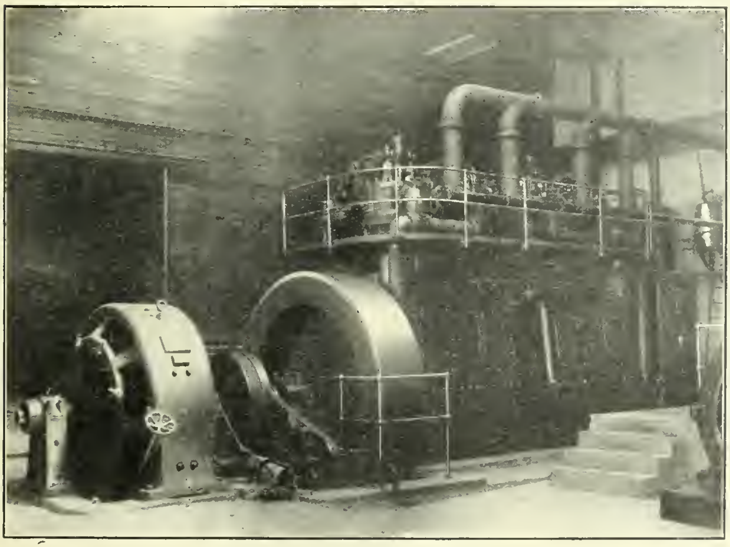
I might mention the street lighting department, also. We have installed 2,200 lights during the last two years, making this city second to none for well lighted streets, and here again, we stand out with the cheapest rate, with one exception, in the Dominion as far as I am aware.

The gross revenue from all our Utilities for the year will be approximately $535,000."

Port Arthur's domestic lighting rate is 4c per 100 sq. ft. plus 3c per kw.h., less 10 per cent.; commercial lighting, 8c per kw.h. for first hour's daily use of installed capacity for 26 days per month and 3c for all excess, less 10 per cent.; power rates, $25.00 per h.p. under class A unrestricted power use, class B $20.00, class C $15.00; metered power $1.30 per month per h.p. of demand for first 10 h.p. and $1.00 for all excess, plus meter charge of 2½c per kw.h. for first 50 hours of maximum demand, 1¾c for second 50 hours and 1c per kw.h. for all excess.

Largest Diesel Unit in Canada

The Moose Jaw Electric Railway Company have recently added a 500 h.p. Mirrlees-Diesel engine and generating plant to their power station and have just placed a repeat order for an exactly similar unit. As the Moose Jaw company originally installed two units of this type, it may be taken as indicating the satisfactory operation of the Diesel engine, and indeed we understand the company are greatly pleased with their experience with this type of machine. The 500 h.p. engine, which is now in daily operation, averaging 18 hours per day, has also shown that the operating expenses are well within the guarantee given by the manufacturers.



500 h. p. Diesel unit recently installed by the Moose Jaw Electric Railway Co.

This is the largest Diesel engine at present operating in Canada. It will be seen from the photograph herewith that it is of the four cylinder type, each cylinder developing 125 B.h.p. The engine is fitted with Mirrlees valve and other patented improvements.

The simplicity and ease with which this large unit is handled is said to be simply wonderful and this, coupled with the fact that it can be started up from cold and put on the load in less than one minute, makes it an ideal prime mover for traction purposes, more especially as there are no stand-by losses when the engine is not running. Another feature is the excellent regulation which takes care of the heaviest fluctuations of the load.

This engine was started up about the middle of the year, since when it has practically been in operation for 18 hours daily. The units have all been supplied by the Boving Company of Canada, who also have the order for the other 500 h.p. unit to be installed in 1914.

As indicating the possibilities for development in the business of electric supplies the Stuart Howland Company, who specialize on line material, illumination fixtures and electric heaters state that during the last year they have added seven travelling salesmen to their sales force and that their sales have largely increased notwithstanding the somewhat unfavorable conditions that prevail in the trade throughout the territory covered, and that their business in electric heating supplies has increased more than 5000 per cent. in five years. In other words, the sales for all kinds of electric heating material for the past year were more than 50 times what they were five years ago.

Electrical Statistics

A copy of the reports, returns and statistics of the inland revenues of the Dominion of Canada for the year ending March 31, 1913, relating especially to weights and measures, gas and electricity, is just to hand and that part of the statistics which deals with electricity is of special interest to our readers.

As is usual the statement includes a table showing the number of electric meters presented for verification, verified, rejected and verified after first rejection. In a number of districts no meters were rejected at all, these being Fort William, Montreal, Sherbrooke, St. Hyacinthe, Three Rivers, and Edmonton representing a total of over 22,000 meters. The total number of meters presented for verification was 118,639 of which only 189 were finally rejected amounting to approximately one-eight of 1 per cent. The complete table is given herewith:—

Districts	Presented for Verification.	Verified as coming within the error tolerated by law.			Rejected			Verified after first Rejection.			Totals	
		Correct.	Fast.	Slow.	Unsound.	Fast.	Slow	Correct.	Fast.	Slow.	Verified.	Rejected.
Belleville.	3,063	1,625	826	611			1				3,062	1
Fort William.	111	38	31	42							111	
Hamilton	7,091	4,140	1,198	1,752			1				7,090	1
London.	5,180	1,838	1,827	1,505	1	4	5				5,170	10
Ottawa	6,112	754	3,650	1,691	5	2	10				6,095	17
Toronto	21,448	10,358	5,909	5,162		4	11	2	1	1	21,433	15
Montreal.	16,130	12,592	2,260	1,278							16,130	
Quebec.	1,303	1,168	20	111			2	2			1,301	2
Sherbrooke..	800	294	219	287							800	
St. Hyacinthe	395	127	197	71							395	
Three Rivers	245	187	28	30							245	
St. John	2,020	761	798	448		7	6				2,007	13
Halifax.	2,752	1,658	803	215	68	1	7				2,676	76
Charlottetown.	192	79	50	60	3						189	3
Winnipeg.	19,279	4,497	9,834	4,941	2	1	2		2		19,274	5
Regina	3,738	1,496	1,663	560	5	7	7				3,719	19
Calgary	6,265	1,668	3,155	1,432		6	1	2		1	6,258	7
Edmonton	4,565	1,768	2,555	242							4,565	
Vancouver.	14,414	5,425	7,212	1,757	1	12	5	1		1	14,396	18
Victoria	3,536	1,756	1,318	460		1	1				3,534	2
Totals	118,639	52,229	43,553	22,655	85	45	59	7	3	3	118,450	189

The statement of revenues and expenditures shows that the total revenues amounted to $74,833.80 and the total expenditures to $42,712.88, leaving a balance of $32,120.92.

A very interesting feature of this government report is that part dealing with the export of Canada's electrical energy which is now reaching very considerable proportions. There were at date March 31, 1913, seven companies exporting electricity into the United States with three more preparing to do so. From the table appended herewith it will be seen that there is more electric energy produced in Canada for export than for home consumption. This is particularly true of the plant at Fort Frances, of the Canadian Niagara Power Company and of the Maine & New Brunswick Electric Power Company. A complete statement is given herewith showing the total amount of electric energy expressed in kw.h. and h.p. years for export and for consumption in Canada by the different hydro-electric companies operating near the border line.

An Active Committee Appointed

At the annual meeting of the Ontario Municipal Electric Association held in Toronto on December 8 it was recommended that the sum of $25,000 be set aside annually for the payment of the three members of the Hydro-electric Power Commission of Ontario. It was suggested that this be apportioned as follows:—Hon. Adam Beck, chairman, $15,000; W. K. McNaught and Hon. J. S. Hendrie $5,000 each. The following officers of the association were elected for the ensuing year:—President, J. W. Lyon, Guelph; first vice-president, E. T. Sifton, Hamilton; second vice-president, Philip Pocock, London; secretary-treasurer, E. M. Ashworth, Toronto; executive, S. Carter, Guelph; W. H. Bradburn, Peterboro; Filbert Roche, St. Thomas; W. D. Euler, Berlin; R. G. Black, Toronto. Along with other business transacted the following resolution was unanimously adopted. This item is commented on editorially elsewhere in this issue. Resolved: That a special committee be appointed to report to the Executive on the advisability of re-arranging this Association on a broader basis following that of the Canadian Electrical Association, and to consider the proposition of an annual convention and exhibition, as well as to arrange for periodical meetings of the engineering and executive heads of Municipal Electric departments, for technical, business and educational co-operation.

Engineers Sifton, Glaubitz and Couzens, and the Secretary-Treasurer, were appointed a committee.

The earnings of the Shawinigan Water and Power Company have shown a continuous increase throughout the year. In January the earnings were $131,000, and in November they had gone up to $138,000, a record for any month. The following tables shows the earnings from 1907: 1913 (eleven months) $1,480,351; 1912, $1,569,671; 1911, $1,349,715; 1910, $991,029; 1909, $819,171; 1908, $706,244; 1907, $581,192.

Name of Contractor.	Place of Business.	Units Produced for Export.		Units Produced for use in Canada.		Total Output of Generating Station or other Source.	
		Kilowatt Hours.	Horse Power Years.	Kilowatt Hours.	Horse Power Years.	Kilowatt Hours.	Horse Power Years.
Ontario & Minnesota Power Co	Fort Frances, Ont.	21,233,520	3,334·20	1,094,513	167·51	22,328,033	3,501·71
Canadian Niagara Power Co.	Niagara Falls, Ont	325,775,842	49,850·25	10,986,988	1,682·24	336,762,830	51,532·49
Electrical Development Co	"	55,034,200	8,421·51	155,773,208	23,837·39	210,807,408	32,258·90
Ontario Power Co..	"	251,286,580	38,912·66	284,950,978	43,603·09	539,237,558	82,515·75
* Electrical Distributing Co	Windsor, Ont						
* Sherbrooke Ry. & Power Co	Sherbrooke, Que						
Maine & New Brunswick Electric Power Co	Aroostook Falls, N.B.	2,371,446	362·89	63,070	9·65	2,434,516	372·54
British Columbia Electric Ry. Co	Vancouver, B.C.	282,383	43·21	120,789,188	18,477·83	121,071,571	18,519·14
Western Canada Power Co.	"	3,259,693	498·80	18,191,562	2,784·87	21,461,255	3,285·67
* Cedars Rapids Power Co.	Soulanges, Que						
Totals		662,243,664	101,423·52	591,849,507	90,462·58	1,254,103,171	191,986·20

* These companies have not yet commenced to export.

Total amount of electric energy generated by border companies.

Electricity in the Manufacture of Lumber

Description of the Application of Electricity in the Largest Lumber Factory in Canada—The Canadian Western Lumber Company's Plant

About three miles above the city of New Westminster on the bank of the mighty stream whose name it bears, the town of Fraser Mills, occupying an area of about 640 acres, makes a powerful bid for distinction as the site of the world's greatest sawmill industry, and a place where community building and development is being successfully worked out under the aegis of a great corporation. As the result of the recent addition of a modern sash and door factory, cedar mill, shingle mill, veneer factory and box factory, the Canadian Western Lumber Company now conducts what is beyond all question the largest lumber manufacturing plant on the globe, the overall capacity being 1,000,000 feet per day of 20 hours, made up as follows:

Main sawmill, 700,000 feet; cedar mill, 200,000 feet; shingle mill, 800,000 shingles; door factory, 2,000 doors; veneer factory, 30,000 feet of built 3-ply panels; lath, 100,000 pieces; box factory (in course of construction), 25,000 feet manufactured boxes in knockdown form.

Woods handled—fir, cedar, hemlock and spruce.

Stock of upwards of 60,000,000 feet of lumber is kept constantly on hand in yards and sheds.

Storage shed capacity for 13,000,000 feet of finished lumber.

Shed capacity for rough and clear kiln-dried lumber, 800,000 to 1,000,000 feet.

Number of employees in plant when running to full capacity, 1000 (exclusive of office staff).

The timber limits owned by the company contain approximately 4,000,000,000 feet. At Comox, Vancouver Island, the firm's logging operations are on a scale unequalled on the American continent, about 750,000 feet of logs per day being handled. Even at this rate of cutting there is a sufficient supply of timber for 45 years.

Power Plant

The power producing department of this manufacturing establishment, with its net capacity of over 6,000 h.p., is considered one of its most interesting features. No expense has been spared to make this part of the plant reliable and convenient in operation. Both the boiler house and machine room are of brick, fireproof construction, and the latter is notably large, excellently lighted and well ventilated.

The boilers, sixteen in number, each 72 in. in diameter by 18 ft. long, are of the H.R.T. type built for 166 lb. B.C. inspection, and are equipped with Dutch oven furnaces. They are grouped in four batteries of four each.

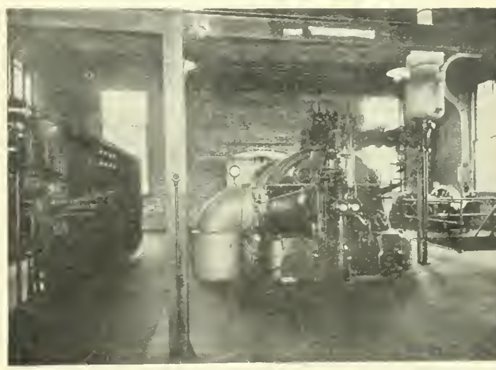
Mill refuse, which is used exclusively for fuel, is carried from the main sawmill by chain conveyors, and from the planing mill by forced draught through cyclones, to the fuel shed at the end of the boiler house. The fuel from there is fed as required by conveyors to chutes, and thence by gravity to the furnaces. This boiler plant, besides supplying all steam necessary for the turbines and engines, also furnishes the required steam for sixteen double track dry kilns.

There are two steel plate stacks, 96-in. in diameter and 40 ft. high, which are used in connection with an induced draught firing system.

While every effort has been made to profitably utilize the by-products there is a large amount of waste material that must be destroyed, and for its disposal the company have erected two burners. The largest of these, supplied by the Muskegon Boiler Works, Muskegon, Mich., and said to be the largest burner of its kind in the world, is used for the disposal of offal from the main sawmill and planing mill. This burner is 54 ft. outside diameter, 50 ft. inside diameter, and has a 2-ft. radial water space. The total height of the burner is 161 ft. with a water jacket 86-ft. high. Circulating water is supplied by a 1300 U. S. gallon motor driven turbine pump. A smaller brick lined burner 42 ft. in diameter and 125 ft. high is installed near the cedar mill, and handles the refuse from this part of the plant, as well as from the shingle mill and sash and door factory.

In the machine room are one 18 in. by 42 in. Allis-Chalmers, twin, Corliss engine operating a 93 r.p.m.; another of the same type and make 22 in. by 42 in. operating at the same speed, and a 30 in. by 36 in. slide valve engine manufactured by the Hamilton Manufacturing Company, operating at 135 r.p.m. These engines are driving, by belts, practically all the machinery in the main sawmill.

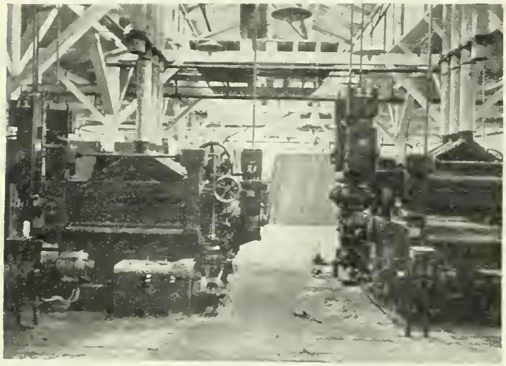
The first electric power generating equipment installed by the company was an Allis-Chalmers 750 kw., 1800 r.p.m. 480 volt, three-phase, high pressure steam turbo-generator. A 10 in. by 18 in. by 18 in. C. H. Wheeler combined single air pump and jet condenser was furnished with this turbine unit.



1500 kw. mixed pressure unit recently installed

When it was decided to enlarge the manufacturing facilities, and to adopt motor drive for all additional equipment, increased generating capacity was required. The three large engines already mentioned were operating non-condensing, and, therefore, deriving only a portion of the available energy from the steam they consumed. It was decided to purchase a turbine so designed that advantage could be taken of this lost energy, and it was also stipulated that the machine should be capable of operating economically on high pressure steam. The machine chosen has a capacity of 1500 kw. at 80 per cent power factor, operating at 1800 r.p.m., and is of the mixed pressure Curtis type. It is designed to operate on high pressure steam at 130 lb. and low pressure steam at 16 lb. absolute, with a vacuum of 28 in., and is capable of carrying its rated load with steam at either pressure, or at both pressures in proper proportions. It is noteworthy that this machine uses high pressure steam in the same economical manner as Curtis turbines designed for high pressure operation only. Steam is admitted to the turbine from the low pressure inlet pipe by a butterfly throttling valve, and from the high pres-

sure line by independent valves serving groups of nozzles. Admission of both high and low pressure steam is controlled by the one governing mechanism, which is so designed that the speed is practically constant under all changes of load and steam conditions. When the entire plant is in operation full output from the generating equipment is required; under this condition the two generators operate on the same bus with satisfactory results. During the working periods of the day there is now available almost exactly 1500 kw. of low pressure steam.



Two 3-drum sanders—Each driven by four motors

Low pressure steam for the turbine is taken from a receiver 5 ft. in diameter by 16 ft. long into which the engine room auxiliaries, as well as the three mill engines, exhaust. The condensing equipment consists of a No. 26 Wheeler Manufacturing Company's centrifugal jet condenser with a 14 in. double suction steam turbine driven tail pump and 9 in. by 22 in. by 16 in. dry vacuum pump. Water from the Fraser river is used for both the condensers and boilers. As a precaution the condensing equipment is of a design suitable for use with salt water.

The main exciter is a 50 kw. 125 volt Canadian General Electric machine operating at 300 r.p.m. and direct connected to a 10 in. by 12 in. Skinner centre crank engine. Another source of excitation is a 15 kw. generator direct connected to a vertical engine. The large machine is of ample capacity for both generators.

The electrical control is notably modern and well adapted for the requirements of this plant. The switchboard consists of eleven natural black slate panels, with a swinging bracket carrying the exciter voltmeter and synchroscope, and a F6 Tirrill regulator. Each main generator panel is equipped with three main ammeters, a voltmeter, a field ammeter and an indicating wattmeter. Each double circuit feeder panel, of which there are six, is equipped with two ammeters. All these instruments are of the horizontal edgewise pattern. On account of the high current capacity and low voltage, solenoid operated carbon-break circuit breakers, controlled by push button switches mounted on the panels, are used for the generators. These circuit breakers have a capacity of 3,000 and 1200 amperes respectively. The feeders are controlled by 500 ampere, automatic, hand operated, remote controlled oil switches. These switches and the solenoid operated circuit breakers are carried on a pipe frame work 5 ft. 6 in. behind the panels, the 480 volt bus being mounted on the same support above the switches. Inverse time limit relays are installed on all automatic circuits. Feeder cables through condulets enter conduit, and are carried down from the switches below the floor. The heavy cable is so arranged that it gives the installation an unusually symmetrical and pleasing appearance. The switchboard and control equipment were supplied by the Canadian General Electric Company.

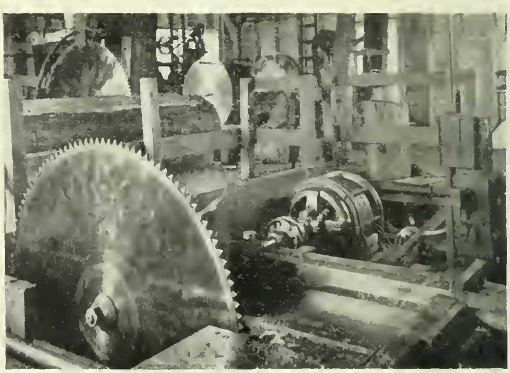
The Motors

The connected electrical horse-power in the various departments is as follows:—

Cedar sawmill	918.5 h.p.
No. 1 planing mill	917.5 h.p.
No. 2 planing mill	544.0 h.p.
Finishing shed	395.0 h.p.
Shingle mill	480.5 h.p.
Sash and door factory	315.5 h.p.
Veneer plant	153.5 h.p.
Isolated machinery and yard equipment	571.0 h.p.
Plant lighting	207.0 h.p.
Town lighting	260.0 h.p.
Total	4,762.5 h.p.

The 200 motors in use vary in size up to 250 h.p. Motors of 100 h.p. capacity and below are of the squirrel cage type. All above this size, and those 100 h.p. units that are subject to heavy starting duty, are of a wound rotor slip-ring design. The system load-factor is approximately 80 per cent., and the ratio of average to connected load is practically 60 per cent. The planing mills, including 620 h.p. in fans, operate at a particularly high load-factor. Individual drives, through flexible couplings, either direct to the machine itself or its countershaft, are used exclusively except where fluctuating load conditions on several machines of a kind make grouping advisable to maintain a steady demand on the motor. The shingle machines, of which there are twelve, are driven in four groups by motors direct connected to the countershafts.

By constantly studying the operating conditions, and by redistributing the motors when necessary to ensure their operation at a maximum efficiency, an average power-factor of 82 per cent. was obtained on the original installation. It was realized, however, that if this power-factor could be improved, desirable operating advantages would be possible. A 350 kv.a. 480 volt, self-starting synchronous condenser with exciter, Tirrill regulator and control panel were installed in No. 1 planing mill at a point where it was considered that the power-factor corrective effect would be most beneficial. Under the same load conditions the effect of the condenser was to raise the system power factor to 94 per cent. The betterment in voltage regulation greatly improved the motor starting characteristics. The latter advantage was especially valuable in the planing mill where the motors have very severe starting duty. A duplicate condenser equipment has recently been purchased from the C. G. E. Co., and is being



Direct connected bolt saw, in shingle mill

installed in the cedar mill where it is expected to benefit operating conditions by compensating for the heavy load fluctuations on the 250 h.p. motor driving the 10 ft. double cutting band mill, as well as on the large motors driving the gang and edger.

When the original motor installation was made, overload protection was provided by line fuses, and an automatic oil switch for each machine. The more recent purchases have called for these features embodied in the starter itself. These compensators have all the good features of the old combination, and some added refinements of design that are distinctly valuable. In this equipment are embodied protection to the motor from overload by series inverse time-limit relays, and against failure of voltage by a no voltage release attachment. The compensator itself is protected by a spring operated handle which makes it impossible for the attendant to leave the compensator switch in the starting position. The equipment is entirely self-contained; it is provided with dust protecting covers and arranged for the entrance of conduit from either the top or bottom. When it is found advantageous, in emergency or for other reasons, to have the attendant, at a point remote from the compensator instantaneously disconnect the motor from the line, a spring switch is installed in the no voltage release circuit of the compensator at this point.

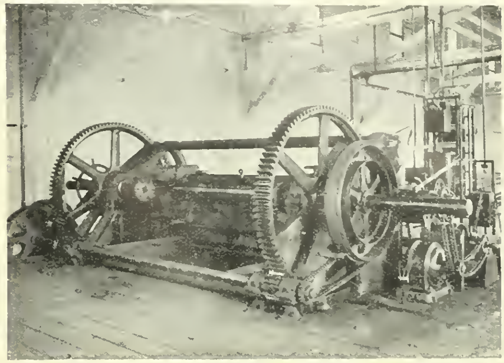
A notable illustration showing the flexibility of the electric drive is the travelling derrick for handling heavy timber as it comes from the mill. This equipment was designed and built by the Canadian Western Lumber Company. The derrick, which consists of a mast supporting a counterweighted horizontal boom 107 ft. long, is mounted on a bed or carriage 40 ft. wide by 80 ft. long that operates on a four track runway extending 850 ft. from the end of the main sawmill, and at the same elevation as the mill deck. The main hoist, operated by a 40 h.p. slip-ring motor, has a lifting capacity of 7,000 lbs. at 150 ft. per minute. The lifting radius may be varied by a movable carriage on the main boom. This carriage is controlled by a 5 h.p. slip-ring motor. A 25 h.p. motor of the same type is used for swinging the boom, and operating the main carriage or bed. All motors are controlled

Sash and door factory containing 38 motor-operated machines

from an operating turret mounted on the main carriage. A three-phase 440 volt trolley is strung at one side of the runway and the current collected by sliding contacts.

The Columbia three drum sanders show that the manufacturers of woodworking machinery fully appreciate the advantages of the electric drive. One 5 h.p. and four 7½ h.p. 1800 r.p.m. motors, with cloth pinions, are used on each of these machines, and belting is eliminated entirely.

Under normal conditions the entire plant is operated at the rate of 20 hours daily and for this reason the artificial interior illumination is an important consideration. A special three and four-light metal reflector has been designed and patented by Mr. Charles Rictor, the electrical superintendent, and this fixture with mazda lamps is used exclusively throughout. The combination provides a high illuminating efficiency, and occupies much less space than the metal



Veneer machine operated by variable speed motor

troughs formerly in use, thus reducing the chances for the accumulation of dust.

The plant is completely wired in conduit, and the electrical installation conforms in every respect with the requirements of the Board of Fire Underwriters. Feeders from the power station run to slate distributing panels in each department. These panels are enclosed in steel cabinets. The out going circuits from the cabinets are fused and at every motor is installed a compensator, as previously described, or an automatic oil switch. All aerial lines are protected by compression chamber, multigap lightning arresters.

A study of the manufacturing results which are being obtained at this mill provides a most convincing argument for the use of electric drive in lumber plants. Almost every phase of the industry is represented at the Fraser Mills and every type of machine utilized is motor driven.

It is interesting to note that the Canadian Western Lumber Company was the first lumber concern in Canada to adopt the use of electric drive on a large scale, a departure which indicated a considerable degree of enterprise, and one which is thoroughly deserving of the commendation of the electrical profession as a whole.

The fact that during the five years of its operation there have been practically no shut-downs in this plant on account of electrical troubles is striking evidence of the foresight and intelligence displayed in arranging and operating the equipment, and also speaks highly of the managing and operating staffs which consist of: Mr. A. D. McRae, vice president and managing director; Mr. J. D. McCormack, secretary-treasurer; Mr. W. S. Rogers, manager of manufacturing; Mr. Chas. Rictor, electrical superintendent.

The city of Winnipeg have awarded a contract to the Siemens Company of Canada for one 500 kw. motor generator set. This is the third set of this size supplied by the Siemens Company to the city of Winnipeg. The motor will be of the self-starting synchronous type, 720 r.p.m., 3-phase, 60 cycle, 2200 volts, direct coupled to a compound-wound, 3 wire, 550/605 volt generator with commutation poles. The contract also includes a direct connected exciter together with shunt and series rheostats and motor starter.

The Closer Regulation of Transformers

By Mr. H. B. Dwight

It is a fact of common observation in electrical engineering that less importance than formerly is being placed on obtaining very close regulation of transformers. A number of years ago every effort was made to secure transformers with as small a percentage of regulation as possible. This was valuable since most transformers supplied lighting loads, and poor transformer regulation produced variations in voltage. At the present time, a constant voltage at the load is just as desirable as ever, but this is not often primarily dependent on the transformer regulation. The average power-factor is lower, due to the increased use of induction motors, and power is distributed to longer distances, and thus the use of potential regulators has become general for providing steady voltage for power users. Therefore, even in local distribution of power, transformers with close regulation are not required as much as formerly.

In large power transformers, close regulation means low reactance, which is now commonly regarded as a distinct

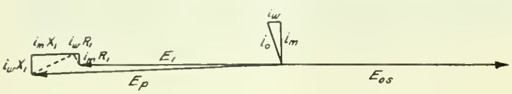


Fig. 1—Transformer vector diagram at no-load.

disadvantage and source of danger, due to the destructive action of the very large currents which flow when a short-circuit occurs.

No matter what percentage of regulation is desired, however, it is quite important to determine the regulation of a transformer accurately. Most manufacturers guarantee a certain regulation for lighting and power transformers. The accurate determination of the regulation and impedance is also required where different transformers are to operate in parallel. The exact formula for calculating transformer regulation from test results, taking complete account of magnetizing current, etc., was carefully worked out some years ago, and is understood and followed to a considerable extent. However, the formula is very seldom published, and not all of the books are in agreement with it, but contain an older inaccurate formula. Accordingly, an explanation of this matter may prove of interest.

According to the Standardization Rules of the American Institute of Electrical Engineers, the regulation of a constant-potential transformer is "the ratio of the rise of secondary terminal voltage from rated non-inductive load to no-load, at constant primary impressed terminal voltage, to the secondary terminal voltage at rated load."* It is therefore necessary to calculate the secondary voltage at both full-load and no-load for a certain constant value of primary voltage. This can be done very easily by consideration of the vector diagram of a transformer (Figs. 1 and 2).

At no-load (Fig. 1), the secondary winding of the transformer is open-circuited, and no current flows in it. However, a current, i_o, called the exciting current, flows in the primary winding. If E_p is the voltage impressed on the transformer, the component i_w, of the current i_o, which is in phase with E_1 represents true power delivered to the transformer. This power is called the iron loss of the transformer. The component of current in quadrature with the applied voltage E_p is i_m, the magnetizing current.

If R_1 and X_1 are the resistance and reactance of the primary winding alone, a voltage drop proportional to them and to the no-load current will be produced in the winding. The voltage, E_1, induced in the primary winding by the transformer flux will therefore be less than E_p by the amount of this drop, as is shown in Fig. 1. Thus we have:

$$E_1^2 = (E_p - i_w R_1 - i_m X_1)^2 + (i_w X_1 - i_m R_1)^2$$

or, since all the quantities are small compared with E_1 or E_p, we have, to a very close approximation,

$$E_1 = E_p - i_w R_1 - i_m X_1 + \frac{(i_w X_1 - i_m R_1)^2}{2(E_p - i_w R_1 - i_m X_1)}$$

$$= E_p - i_w R_1 - i_m X_1$$

since the last term is quite negligible in a practical case.

When a load is connected to the transformer (see Fig. 2), a current I_s at a lagging power-factor, $\cos\theta$, flows in the load and in the secondary winding. Let P be the component of load current in phase with the secondary terminal voltage E_s, and let Q be the lagging reactive component. These currents will produce a drop in the secondary winding so that the voltage induced in the secondary winding will be larger than E_s and will be equal to E_2, where

$$E_2^2 = (E_s + P R_2 + Q X_2)^2 + (P X_2 - Q R_2)^2$$

The same voltage, multiplied by the ratio of turns, is induced in the primary winding, and is E_1. The current flowing in the primary winding is made up of a current whose ampere-turns will exactly balance, both in phase and magnitude, the ampere-turns of the secondary current, and an additional current necessary to magnetize the transformer and supply the iron loss. It may be assumed that this additional current is made up of i_m and i_w, the same as at no load, and that they are in phase with Q and P respectively. The error involved in this assumption will be exceedingly small, as is mentioned later. Then, referring all quantities either to the primary or secondary by means of the ratio of turns, and letting $R = R_1 + R_2$ and $X = X_1 + X_2$ we have

$$E_p^2 = (E_s + PR + QX + i_w R_1 + i_m X_1)^2 + (PX - QR + i_w X_1 - i_m R_1)^2$$

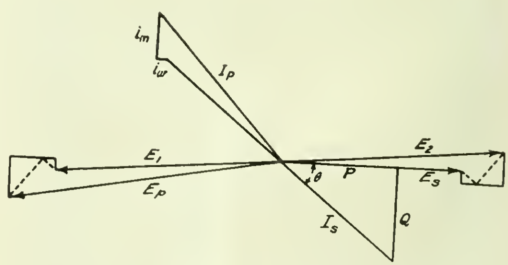


Fig. 2—Transformer vector diagram at full-load.

Thus, to a very close approximation,

$$E_p = E_s + PR + QX + i_w R_1 + i_m X_1 + \frac{(PX - QR)^2}{2 E_s}$$

$$\text{or, } E_s = E_p - PR - QX - i_w R_1 - i_m X_1 - \frac{(PX - QR)^2}{2 E_s}$$

Now from Fig. 1, the no-load secondary voltage is

$$E_{os} = E_p - i_w R_1 - i_m X_1$$

The regulation is

$$\frac{E_{os} - E_s}{E_s} = \left\{ PR + QX + \frac{(PX - QR)^2}{2 E_s} \right\} \frac{1}{E_s}$$

* Trans. A.I.E.E., 1911, p. 2553, par. 197.

or, if R and X are the percentage resistance and reactance drops, and P and Q the power-factor and reactive factor of the load, expressed in decimals, then the regulation is

$$PR + QX + \frac{(PX - QR)^2}{200} \text{ per cent.}$$

This is the standard formula for transformer regulation by test measurements, and it is mathematically correct, including all effects of magnetizing current, etc., to a greater degree of accuracy than is found in test measurements or slide rule calculations. This statement is checked up by calculating out in detail the example given with this article. The effect of the approximations is seen to be negligible.

A formula has been published and is still sometimes put forward, which contains errors that are not negligible, though apparently an attempt has been made to make the formula exact. It is as follows:

$$\text{Regulation} = PR + (Q + i_m)\, X + \frac{[PX - (Q + i_m)\, R]^2}{200}$$

where the various quantities are expressed as percentages and are all referred to either the high tension or low tension. There are two obvious errors in the above formula: first, i_m should never be multiplied by X but only by X_1, the primary reactance, which is approximately equal to ½ X, and second, since i_m is present at both no-load and full-load, it has no appreciable effect on the regulation, which is the difference between no-load and full-load conditions. Along with the above formula there has been given the instruction to divide the result by the quantity (1 + Reg'n.) in order to obtain a final corrected result. This is not correct, for the regulation should be expressed as a percentage of the secondary full-load voltage, as is done in the standard formula derived above.

The following short example illustrates the procedure in using the standard regulation formula: rating of transformer, 100 kv.a., single phase, 100 amps., 1000 volts (i.e., secondary full-load voltage = 1000); total resistance referred to secondary, 0.08 ohms; percentage resistance drop, R = 0.8 per cent.; total reactance referred to secondary, 0.5 ohms; percentage reactance drop, X = 5 per cent.; iron loss, 700 watts = 0.7 per cent.; magnetizing current, 6 amps. = 6 per cent.

Find the regulation at 80 per cent. power-factor of load.

$$P = 0.8$$
$$Q = 0.6$$

$$\text{Regulation} = 0.8 \times 0.8 + 0.6 \times 5 + \frac{(0.8 \times 5 - 0.6 \times 0.8)^2}{200}$$
$$= 0.64 + 3.00 + 0.06$$
$$= 3.70 \text{ per cent.}$$

According to the incorrect formula given above.

$$P = 0.8$$
$$Q = 0.6 + 0.06 = 0.66$$

$$\text{Regulation} = 0.8 \times 0.8 + 0.66 \times 5 + \frac{(0.8 \times 5 - 0.66 \times 0.8)^2}{200}$$
$$= 0.64 + 3.30 + 0.06$$
$$= 4.00 \text{ per cent.}$$

Thus the error is 0.30 per cent. of rated voltage, which is quite noticeable. The error due to dividing this quantity by 1.04 is also seen to be considerable.

That the assumptions involved in deriving the standard regulation formula are of negligible effect may be seen from the following detailed calculation of the same example. At full-load, we have

$$E_p^2 = (E_s + PR + QX + i_w R_1 + i_m X_1)^2 + (PX - QR + i_w X_1 - i_m R_1)^2$$

$$E_p = 1000 + 6.4 + 30 + 0.028 + 1.50 + \frac{(40 - 4.8 + 0.175 - 0.24)^2}{2 \times 1038}$$
$$= 1037.93 + 0.59$$
$$= 1038.52$$

If we neglect the effect of the exciting current in the last term, and use the round number 1000 in its denominator, as is done in the standard formula, we obtain

$$E_p = 1037.93 + \frac{(40 - 4.8)^2}{2 \times 1000}$$
$$= 1037.93 + 0.62.$$

The difference is 0.03 volts or 0.003 per cent. of rated voltage, which is negligible.

At no-load, keeping E_p equal to 1038.52, we have

$$E_{os}^2 = (E_p - i_w R_1 - i_m X_1)^2 + (i_w X_1 - i_m R_1)^2$$

$$E_{os} = 1038.52 - 0.028 - 1.50 + \frac{(0.175 - 0.24)^2}{2 \times 1037}$$
$$= 1036.99 + .000002.$$

The last term is seen to be entirely negligible, as was stated in the description of the no-load diagram. The regulation is equal to

$$100\, \frac{E_{os} - E_s}{E_s} = \frac{1036.99 - 1000}{10}$$
$$= 3.70 \text{ per cent.,}$$

as was obtained by the standard formula. The other approximations produce differences of the same small order of magnitude as those shown above.

Battery Charging by Motor-Generator

One of the big factors to be considered in the purchase of an electric vehicle is the charging of the storage batteries. Up to the present time this charging operation has been attended to, for the most part, either in the ordinary gas car garage or by the central station owner who has installed special equipment for the purpose. Nearly all electric supply is alternating current and as batteries can only be charged with direct current it has been necessary to install equipment to change the alternating current to direct. As this equipment is somewhat expensive and as its operation calls for more or less technical knowledge, it has not been possible for the vehicle owner to install it, in his own garage, the necessary equipment for charging his batteries.

There may be said to be four general methods of rectifying an alternating current. These are, first, by chemical means such as the aluminium cell; second, mechanical means as, for example, the synchronous commutator; third, electro-chemical rectification of which the mercury arc bulb is the commonest example; fourth, magneto-mechanical means of which the commonest is the motor-generator set. In the recent past the equipment most generally used in small capacity work is the mercury arc rectifier, but there has recently been placed on the market by the Electric Products Company of Cleveland, through their Canadian agent R. E. T. Pringle, a vertical type of motor generator-set which is claimed to be suitable for small individual garages and to overcome many of the difficulties experienced with other types of rectifier. Regarding the vertical type machine the manufacturers have this to say:—

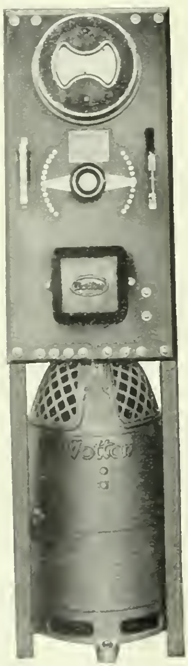
"Broadly speaking, for battery-charging purposes the ideal machine would first be vertical instead of horizontal. This conserves floor space, where, in most instances, it is of much value and convenience. This type also eliminates the component gravity and centrifugal forces, and the result is a more perfectly balanced machine, as, in the vertical type, the dead weight, or gravity force, is applied at the center of

the shaft, and, therefore, does not affect the centrifugal forces of rotation.

Lubrication is a prime necessity. In the hands of the typical woman operative, no attention will be given to lubrication. This element of design must have the same margin of safety built into it as is found in her car. Bearings must, therefore, be automobile type ball bearings, running submerged in oil. Otherwise, frozen bearings are sure to follow, dust and foreign substances are sure to enter.

It is not necessary to consider the matter of speed reduction, as these machines are not applied to driving machine tools. Highest efficiency can be secured in higher speeds than those commonly found. Space and weight decrease as speed increases. The speed shall be as high as good engineering considerations will permit. Commutator velocities largely govern this. This must not exceed 5,000 ft. per minute, which is good turbo-generator practice.

A machine of this type, in the generator end, should have an inherently flexible variation of characteristic to adapt itself readily to either constant current or tapering charging rates, according to the type of battery to be charged.



Vertical type motor-generator set.

The ideal vertical rectifier has three disadvantages:

1. A higher manufacturing cost.

2. A lower electrical efficiency.

3. Renewals to brushes, bearings and oil occasionally.

But to offset these disadvantages this high-speed vertical rectifier presents:

1. A very high commercial efficiency. This applies to all voltages, being practically constant throughout the entire voltage range.

2. A flexible voltage range. Field resistance regulation in a direct-current generator is extremely flexible and the losses are exceedingly slight.

3. A standard type of apparatus that every electrician understands. This results in quick repairs and few operating interruptions.

4. Close regulation at variable line voltages. The speed of an alternating-current motor depends upon the frequency of the supply current rather than the voltage. As the voltage varies, however, the slip of the motor below its synchronous speed varies almost in proportion to the variations of voltage. The direct-current voltage varies directly as the speed of the motor. Therefore, fluctuations of the supply alternating-current line voltage will affect the direct-current voltage, and, therefore, the charging rate to a less degree than is found in any other commercial machine built. Plate 5 shows the true regulation of the ideal rotary rectifier.

5. Automatic restarting is easily accomplished through simple solenoid switching devices that have become standard in thousands of different industrial applications.

6. A very flexible adjustment for tapering or constant-current charging rates. In commercial vehicle applications, especially, this is an enormous advantage. Under ordinary circumstances, for a lead battery it would be desirable to allow the regular charges to proceed at tapering rates throughout the charging process. During times of emergency, and after battery capacity begins to materially lessen, it will add greatly to the usable life of that battery to be able to give it a constant-current boost during spare hours of the day.

Therefore, to sum up the relative value of the various types of rectifying apparatus for use in unattended garages, where simple and dependable operation is of first importance, and a high commercial efficiency is equally desirable, there can be little discretion as to the relative merits of a motor-generator, designed after these lines and that of any other afore-mentioned types.

Uninterrupted service first, then economy, is the order in which the importance of these varied machines must appear to the owner of the unattended garage."

A very important feature of the new machine is its control, by an instrument of the voltmeter type and to which the name, on account of certain characteristics, Soakometer has been given. This meter is shown at the upper part of the accompanying illustration and carries two graduated scales. The lower scale is for reading volts and amperes, the latter being accomplished by simply pressing a button which cuts out the high resistance of the voltmeter. On this scale there is also a second indicator or pointer which moves concentrically with the indicator and is set, for the average charge, a little below the absolute maximum, which is determined by test and checked with the gravity readings. On the rear end of each of these pointers on the lower scale there is located an engaging contact and the coincidence of these pointers, brought about by the voltmeter needle gradually rising, allows a current to flow and sets a clock work in motion. The clock work is situated in the upper part of the meter and the pointer shown on this upper scale is simply the hour hand of the clock. As the clock operates this hand moves slowly across the scale from left to right and on reaching the extreme right hand side finally engages a contact which operates the main line circuit breaker and cuts off the current. This clock hand may be set at any point in the scale so that, in actual operation, any time from the maximum down to zero may elapse between the instant when the two lower hands first come together and the instant the current is finally shut off. This latter time element during which the cells continue to be charged after the maximum voltage has been reached, in other words during which time the soaking charge is being given to the cells, is the origin of the name given to the instrument.

In addition to this special and valuable feature it is pointed out that a short circuited cell is also indicated by the failure of the two lower pointers to engage, and while this at first sight would appear to be a defect in the instrument it has proved one of its most valuable points.

Testing of Telephone and Telegraph Lines*

By Mr. T. H. Nicholson

Line Testing With a Voltmeter (con.)

The circuits shown on Figs. 17, 18 and 19 are equally applicable to ballistic tests, that is, to note the presence or absence of capacity. To ascertain this on L_2 the "VM" key is operated and released and the temporary deflection noted, which is the capacity from L_2 to ground which might be a condenser at "X." The same is true of L_1 except that for this test both the "VM" and "reverse" keys are operated, but only the "VM" key released to note the capacity deflection. For observing the capacity across the line, or between the wires L_1 and L_2, the "VM" and "ground" keys are operated, and the "reverse" key alternately operated and released to get the deflection.

In addition to these three fundamental tests the keyboard is usually arranged to permit of the telephone circuit being connected onto the line when desired. Keys are also provided to use a shunt coil, or to cut out the testing battery in order to observe foreign potentials. The use of these is similar in all important respects to like functions of another test circuit of different principles to be later described, so no effort will be made to detail them here.

Nearly all testing keyboards designed on the principle outlined above are so arranged that when the key, or combination of keys, for any particular test is operated the rest of the circuit is cut off. This is in order that no confusion can occur by throwing two or more distinct tests together. This feature is of value when those using the circuit are not very familiar with it, but on the other hand it is a serious drawback to a good testman who thoroughly understands the arrangement, and who may be able to combine tests and thus save time, or duplicate conditions not otherwise possible.

Then, the use of a grounded voltmeter is occasionally a drawback, as, for instance, when it is desired to measure the loop resistance of a line that is grounded on one side. This is clearly illustrated in the example of trouble locating given with Fig. 20, where, after measuring the resistance on each

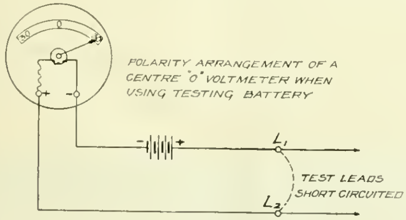


Fig. 21

side of the line to the cross, it was desired to measure the line itself to check with the apparent resistance derived from the two single measurements. Obviously this cannot be done, and the only alternative available, failing a definite record of the line, would be to measure with a bridge.

Universal Testing Circuits

It will be assumed in the following explanation of universal testing circuits that the reader has to do with telephone systems using a three-wire circuit in the central office part of the subscribers line, that is, a pair of wires for the talking circuit, and a single wire, usually associated with the pair, for controlling the line relay, or other signalling apparatus, and to provide means of obtaining a busy test. The testing circuits can be more conveniently shown under these conditions and it is not a difficult matter to apply the methods outlined to systems using two wires only. These three wires will be spoken of as L_1, L_2 and L_3, corresponding to tip, ring and sleeve, or line, return, and test, as the case may be. This point should be thoroughly understood, and proper definitions made when applying circuits or methods given to actual conditions, for the reason that the accuracy, and sometimes the very operation, will depend upon the correct relation of the several wires.

The circuits to be described are called universal for the reason that by a correct manipulation of keys any known test can be made on a line without any further change in the arrangement. Usually a testboard is so arranged that only a few tests can be made with any one of the several test cords. If a voltmeter test is required then the voltmeter cord

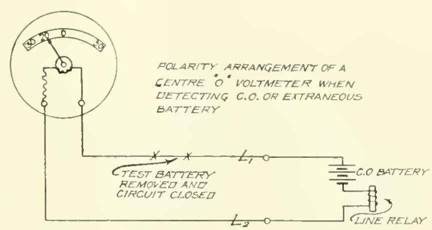


Fig. 22

is used, and so on, but with this arrangement it is possible to take up a line with the one test cord and make all the tests that are provided in the complete circuit. This has, incidentally, an appreciable value on routine testing alone, especially in these days when more attention is paid to anticipating trouble than formerly, and the extent of this anticipation is largely governed by the ease and quickness with which tests can be made, and consequently by the facilities at hand.

The requirements for these testing circuits are such that the grounded voltmeter had to be abandoned and also, with it, the system of having each distinct test cut off all others, except, of course, in such instances where there is no advantage to be gained by making them together, or where awkward or perhaps dangerous conditions might result from throwing them together.

It has been found by experience that a voltmeter of the center "O" type is the best for these testing circuits, and that a 30-volt testing battery is sufficiently high for local line testing. It is also known that the most accurate results are obtained when the voltmeter has an internal resistance not much greater than the highest resistance to be measured. The average insulation trouble is not much higher than 3000 ohms, so a voltmeter having approximately this resistance is accurate enough for all practical purposes. This is specially mentioned because voltmeters of this type and range usually calibrate with a resistance around this figure, and it is therefore unnecessary to go to the expense of having an instrument designed to calibrate to any definite resistance.

The center "O" type instrument is used for several reasons. The most important of these is that the polarity of any current causing a deflection is immediately known, and without the necessity of consulting the keyboard. This is useful when dealing with extraneous currents, or when measuring or detecting the central office battery. The circuit is

arranged so that the testing battery is always used with its negative pole connected directly to the negative side of voltmeter, and as nearly all central office batteries have their live side negative, the testing battery always gives a positive or right hand deflection, and the central office battery a negative or left hand deflection.

Fig. 21 shows the schematic design of a voltmeter circuit of this type with the test leads short circuited, thus giving a full scale deflection in the positive direction and indicating a closed circuit without any appreciable resistance in the test leads. Fig. 22 shows the same voltmeter with the test battery removed and the circuit closed through to the test leads. In this case there is a deflection of 20 which simply means there is 20 volts at the test lead terminals, but does not indicate what the full voltage of the source of current is, nor the resistance of the circuit over which it is being observed. If it is known however, by other tests that this is the central office battery, then the resistance in the circuit can be determined in the same manner as would be followed if it was the testing battery itself, and assuming it to be 24 volts and the voltmeter 1000 ohms, the resistance must be, from the formula before given:—

$$\frac{D \times V}{d} - V = \frac{24 \times 1000}{20} - 1000 = 200 \text{ ohms.}$$

If there is any doubt that it is the central office battery, then it must be determined by a Wheatstone bridge method (to be later described) by which the resistance can be first determined and from that the voltage obtained through it.

It is fairly standard practice in telephone systems to have the negative or live side of the central office battery connected to the L_1 or ring side of the line; for this reason the positive pole of the voltmeter is connected to the L_1 side of the test circuit and the negative side to the negative side of the test battery, with the positive side of the test battery connected to L_1 of the test leads, thus making it unnecessary, as before explained, to reverse the test leads in order to make any test or measurement. An exception to this will sometimes occur when the voltages greater than the range of the voltmeter are encountered, as for instance when measuring the extra, or booster, battery used for toll work. As this battery is also negative on the L_1 side it can be measured by leaving the 30 volt test battery in circuit and noting the negative deflection with the two currents opposing; this may be up to 18 volts depending on the amount of resistance in the circuit. Some other instances develop which will occur as the explanation of circuits and methods proceeds.

Personals

Hon. Adam Beck sailed for England during the second week in December per s.s. Olympic.

Mr. J. Sanger, late superintendent of distribution for Light and Power Department, Winnipeg, has accepted a position with the Winnipeg Branch of the Siemens Company of Canada, Limited.

Mr. J. B. Sunderland is severing his connections with the British Columbia Electric Railway Company, with which he has been connected for the past five years, filling an important post in the comptroller's department.

Mr. Th. Seidl, manager and chief engineer of Messrs. Escher Wyss & Company, Montreal, started on a short trip to Switzerland on the 16th December. Mr Seidl expects to be back in Montreal on 20th January. During his absence Mr. Withers will be in charge of the office.

Mr. C. B. Vorce, who has for the past three years occupied the position of construction engineer with the British Columbia Electric Railway Company, recently severed his connection with that concern. During his residence on the coast Mr. Vorce has ably carried out the exceptionally heavy duties devolving upon him because of the large amount of construction and maintenance work which his company was compelled to undertake. He leaves Vancouver after having won golden opinions both from the engineers with whom he has been associated, as well as the business men with whom he came in contact. It is probable he will utilize his engineering ability and experience in consulting engineering work in New York.

Mr. W. C. Gordon has been appointed Transportation Engineer for the Canadian General Electric Company, Limited, and will take charge of all inquiries in connection with electric traction. He has wide experience in connection not only with city and interurban electric traction, but also trunk line electrification. After graduating from Cornell in electrical engineering in 1899 he entered the testing department of the General Electric Company at Schenectady. While in the Railway Construction Department he had charge for the General Electric Company of the installation of the first electrically operated train on Manhattan Elevated, New York, and later of the installation of the first multiple unit equipments for the Northwestern Elevated Chicago, Aurora, Elgin and Chicago Railway, Lake Shore Electric Railway, etc. Later while in the Railway Engineering Department at Schenectady he was closely associated with the further development of multiple unit operation for the New York Central lines and the Interboro Rapid Transit Company. He later went to Australia in the General Electric Company's railway interests and was manager and engineer of the North Melbourne Tramways and Lighting Company, Limited; later he was engineer for the National Electrical and Engineering Company, Limited, handling the New Zealand business for the General Electric Company and, finally, engineer for the Brisbane Tramways Company, Limited, until his return to Canada. Mr. Gordon is a son of Principal Gordon, of Queen's University, Kingston.

Trade Publications

P. & S. Equipment—bulletin 829, issued by Pass & Seymour Inc., describing, with complete illustrations, their handy electrical wiring devices.

House-Number Condulets—A pamphlet issued by the Crouse-Hinds Company of Canada, describing and illustrating this new type of condulet.

Stock List—Issued periodically by the Crouse-Hinds Company of Canada containing a list of material or parts which can be shipped immediately upon receipt of order. The latest list deals with panel boards and cabinets.

Storage Batteries.—Bulletin No. A4131 issued by the Power & Mining Department of the Canadian General Electric Company describing storage batteries, industrial and mining locomotives. The bulletin is well illustrated and some interesting figures are given on the design and operating costs of this equipment.

Cedars Making Good Headway

The Cedars Rapids Manufacturing & Power Company have just issued their second report on work completed to date December 1, 1913. Splendid construction progress has been made as is shown by the fact that concrete work in the power house is completed for three of the ten units and partially completed for the others. Three turbines and three generators are already on the ground and it is expected that the work of erection of these will be commenced about the first week in the new year. The report is illustrated with very interesting construction views, one of which shows the large movable cantilever crane used in placing the concrete, etc.

Illumination

Street Lighting of Westmount

The city of Westmount, P.Q., have recently improved their system of lighting by installing 50, 6.6 ampere magnetite arc lamps, supplied by the Canadian General Electric Company, on Western Avenue. This type of lamp and the mercury arc rectifier equipment were fully described by Mr. L. Burpee in our issue of October 15.

Western Avenue is over a mile in length, and lends itself to an effective system of lighting. It is now the best lighted thoroughfare either in Westmount or Montreal, the difference between the old system of 4 amp. arc lamps and the present system being very marked. The work was done under the supervision of Mr. G. W. Thompson, the general manager, for the City Council, the owners of the civic lighting plant.

The lamps are installed on ornamental standards, spaced approximately 230 feet apart on both sides of the avenue, with a lamp at the corner of every block. The globes surmounting the standards are heavy opal. The globes at the corners have the names of the streets painted on them. The current is supplied by means of underground cables.

The latest type of mercury arc rectifier is installed in the power house, together with a spare unit, for use in case of necessity.

The city have constructed a trunk line of conduits on Western Avenue, from the city limits on the east to the city limits on the west. The purpose of the system is to take care of all companies through cables and the police call and fire alarm systems. It is proposed to gradually extend the conduits so that all main feeders will be placed underground, thus enabling all poles to be removed with the exception of lamp poles. In Western Avenue the poles will be entirely abolished, the Bell Telephone Company having constructed their own conduits on this thoroughfare.

The Westmount Council have further improved the light of the city by installing 55 on-light 150 watt tungsten standard lamps in Westmount Park. Armored cable, placed underground, carry current to these lamps.

Over-Head Lighting for Industrial Purposes

By Mr. J. L. Stair

Generally speaking, for shops and factories two classes of lighting are resorted to, i.e., the general system and the localized system. In the one case the lamps are mounted above the heads of the workmen giving a uniform lighting in all parts of the room, and in the other case individual lamps on drop cords or brackets cause a strong light to fall upon the work, leaving the rest of the room in comparative darkness. Since there are very few instances in which local lighting is necessary, the general over-head system will fulfill most of the requirements of good lighting, and do it economically.

Of the many advantages of the over-head system of lighting, the following are probably the most manifest. To begin with, the room with an absence of drop cords presents a very clean cut appearance, and in many cases an unobstructed view may be had form one end of the room to the other. This system also adds a cheerful appearance to the room, since the whole area is uniformly lighted. It also makes available for working purposes every square foot of floor space. The workman for whom the lighting is really intended receives the greatest benefit, the light reaches him from several directions and the lamps, being out of the range of vision, add to his ocular comfort and eliminate the glare which is considered the most dangerous feature of modern illumination. The workman saves time in looking for tools, and the annoyance of handling and adjusting the drop cords is done away with. As a result of all this he can turn out a better product with a smaller percentage of spoilage.

The many advantages of good illumination can be easily secured by the correct application of a few simple principles. Though these principles have been laid down many times before, they are nevertheless frequently lost sight of before

Western Ave., Westmount—Twilight scene.

Western Ave., Westmount, by day.

the lighting equipment is finally selected and installed. We should keep in mind then in the solving of shop lighting problems, the following:

tt(1) Shield the light source and keep it out of the range of vision.

(2) Provide plenty of light.

(3) Give the light proper direction.

(4) See that the light is properly diffused.

(5) Keep the system up to its original standard of efficiency.

All of the above are to be accomplished in the most economical way as regards current consumption, first cost of wiring and installation, and maintenance expense. A little careful planning and supervision will greatly simplify the working out of the lighting for seemingly complicated requirements. Select the proper size of lamp for your needs; obtain reflectors that will most efficiently reflect the light and protect the lamp; determine with great care the location of the lighting units, their height and distance apart; and establish a regular schedule for the cleaning and renewing of the equipment—you will then have accomplished practically all that is embodied in the five essentials above.

The satisfactory character of the results obtained by the over-head system of lighting for shops, is shown by the illustrations herewith. Attention is called to the evenness of illumination, distinctness of detail, the clean cut appearance of the rooms and lack of glare from light sources. The work room shown in Fig. 1 illustrates a most efficient use of every square foot of floor area, with the consequent necessity for an equally efficient lighting system. As a matter of engineering information it may be noted that the reflectors are arranged on 10 ft. centres in rows 11 ft. 3 in. apart; the distance from the floor to the lamps is 11 ft.; and the work tables are 32 in. high. Each lamp and reflector unit supplies eight men with adequate illumination at an expenditure in wattage of about .66 watts per square foot.

The writer has in mind an excellent illumination effect, using a similar system to that in Fig. 1, in a woodworking factory and we quote the words of the engineer of the plant:

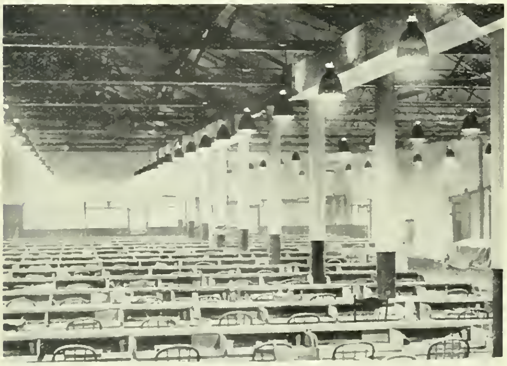


Fig. 1—Overhead lighting in work-room.

"This room is 116 ft. long, 50 ft. wide, and 13 ft. high. The roof is inclined, so that it is 12 ft. on one side and 14 ft. on the other. We have forty 100-watt lamps in reflectors placed on 10 ft. centres, 9 ft. above benches. Before installing the over-head system of lighting, each bench and its table had three small 16 c.p. lamps. These, aside from the annoyance due to handling, were unsatisfactory in the lighting. There is not a single light now used other than the ceiling reflectors. This effects a very material saving, as each workman was compelled to adjust his lamps to every new position he assumed. This required time, and as each man had three lamps they were quite busy adjusting lights."

In a great many shop installations it is necessary to light very thoroughly the vertical surfaces of machines and work. This can best be accomplished by the installation of reflectors similar to that illustrated in Fig. 2. A system of this character, as well as lighting the vertical surfaces, also provides a good uniform illumination on the floor and on horizontal surfaces. The reflectors installed in this case are non-symmetrical in their design, and are so constructed as to

Fig. 2—Illuminating vertical surfaces.

direct most of their light at an angle rather than in a downward direction. They are placed in rows, the individual reflectors being about six feet apart.

As stated above, the placing of reflectors and lamps, has an important influence on the uniformity and direction of the light received by the workman. A symmetrical arrangement of units as shown in Fig. 1, has the outlets spaced an equal distance apart. Each lamp and reflector takes care of a certain square area and the total result is a uniform illumination, that is, if the intensity of light were measured on the floor it would be nearly equal in all parts of the room. This symmetrical arrangement is ideal for shops or work rooms in which the character of the operations or work is much the same. In the case of the work room illustrated, it was necessary to provide a uniform arrangement of outlets, because of the close seating of the workmen. In other cases a more or less grouped arrangement of lamps has to be adhered to, that is, a number of reflectors are placed above a group of machines or benches, and the system of squares described above for Fig. 1, is not carried out. The arrangement in many cases is affected by the presence of over-head shafting and belts. An advantage of this grouping, is, that it provides the greatest intensity of light where it is most wanted. This system is used extensively in shop lighting and is a good one to follow where a diversity of processes or operations are being carried on, which may require varying intensities of illumination. In a general over-head lighting system the units should be placed well above the plane or work to be illuminated, and the most efficient reflectors installed to throw the light down where it is needed.

A provisional agreement has been made between the town council of Barrie and the Toronto, Barrie & Orillia Electric Railway Company. The first section of the road is to connect Barrie with a point on the C. P. R. at Midhurst. Work on this section is to commence not later than April 16, 1911.

Electric Railways

Latest Practice in Street Railway Lamps

By Mr. J. L. Staley*

Before attempting to describe the present practice in street railway car illumination it is useful to make a brief review of past practice. In the past, 64-watt carbon lamps of approximately 16 candle-power, operating at an efficiency of about 4 watts per candle were commonly used. These were 105 to 130-volt lamps operated five in series on circuits of 525 to 650 volts. Three, four and five circuits, of five lamps each were commonly used, the number of circuits depending on the size of car, the various forms of grouping and general arrangement, such as clusters of fives or double rows of single lamps.

The 42-watt lamp of approximately 10 candle-power was used by a few railways, while the 114-watt lamp, giving approximately 32 candle-power, was sometimes used where more illumination was required, or where it was felt that the saving in the number of sockets employed would justify a larger lamp.

The carbon street railway lamp, however, had certain limitations. It was found that, with the increase in street railway schedules due to the growth of any community, there was at certain rush hours a drop in voltage, which, with carbon lamps, made a very marked decrease in resultant illumination. While these rush hour periods were of short duration, they unfortunately occurred at a time when street railway companies were attempting to serve the greatest number of people. During these rush hours the motors were operating satisfactorily, although not quite as efficiently, and as speed was not so important at this time, the railway companies did not feel justified in increasing the feeder capacity to take care of lighting alone. There was therefore need for a lamp of better regulation, that is, one which would maintain more nearly constant candle-power over a wide range of voltage.

Aside from the fact that more nearly constant illumination was desirable, the increase in the standard of illumination throughout the country in all places where artificial illumination was used, such as the home, factory, street, etc., made it also desirable to increase the illumination in the car. That is, illumination which a few years ago was considered adequate, today would not meet with public approval.

The inherent regulation of the mazda lamp, i.e., increase in resistance with increased voltage tending to check an increase in current, together with its high efficiency showed that this class of lamp was almost ideal for street railway service. It only remained to prove the ability of this lamp to stand up under railway operating conditions.

There have been four mazda lamps standardized for regular street railway service, as shown in the following table. The 23-watt lamp was primarily designed for the replacement, lamp for lamp, of 64 and 42 watt carbon lamps. When replacing the former, it gives a slight increase in candle-power at normal voltage, but a steady candle-power over a wide range of voltage, thereby giving sufficient illumination at under-voltage where the illumination of the carbon lamp is not sufficient under these conditions. The 23-watt lamp also effects a considerable saving in current, amounting in some cases to one kilowatt per car.

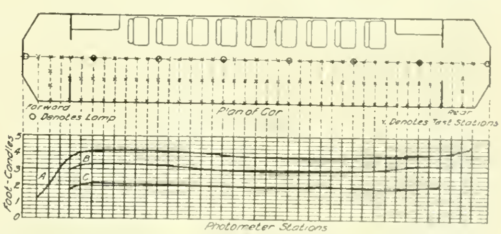
Description	Voltage groups	Nominal watts	Efficiency w.p.c.	Diam. bulb in in.	Overall length in in.
	105	23	1.34	2 3/8	5 1/4
Straight	to	36	1.34	2 3/8	5 1/4
side	130	56	1.20	2 5/8	5 1/2
		94	1.20	3 1/16	7 1/8

The 36-watt lamp is designed for deplacing, lamp for lamp, the 64-watt carbon lamp, and, while affording a decided increase in the illumination of the car, still effects considerable saving in current. The 56-watt mazda lamp is intended primarily for use with Holophane reflectors, using only two circuits of lamps. The 94-watt lamp was also designed for use with reflectors, and is generally used in single circuits.

Construction

Improvements in the method of drawing tungsten wire have, of course, resulted in improved strength of the lamp; this, together with improvements in the methods of mounting, has made the mazda lamp satisfactory for practically any street railway service.

Another decided advantage of the drawn wire mazda



Distribution curves for 34 ft. car equipped with 56 watt railway mazda lamps and clear reflectors. A, along centre line of car body 3 ft. above the floor. B, half way between the centre line of the car windows 3 ft. above the floor. C, along window sills.

lamp is the ability of the manufacturer to draw this wire to exact diameters, which means that in series operation all lamps in series are operating at the same efficiency and that manufacturers can supply lamps for an exact amperage. This enables street railway companies to obtain lamps at any time which will operate satisfactorily in series with those already installed, and to secure uniform brilliance of every lamp in the car.

In the manufacture of these lamps it is the present practice to use one size of wire for each size of lamp, regardless of the voltage; that is, the filament diameter is selected for lamps of a certain wattage rating at 11[illegible] volts and the filaments are cut longer or shorter, depending upon the voltage desired. This means that the wattage of the lamp would be

* Harrison Works, General Electric Company.

slightly higher for higher voltage, and slightly lower for lower voltage; but this variation is not objectionable.

Street railway mazda lamps are operated at somewhat poorer efficiency than lamps for regular multiple service, due chiefly to the fact that the cost of current is low and fairly long lives are justified.

An interesting point in connection with the operation of mazda lamps is that, when a failure occurs due to breakage of the filament, these lamps often re-weld themselves due to the vibration of the car. Although when this occurs it slightly changes the total resistance of the circuit, the efficiency at which these lamps are rated takes care of the slight increase in current which might result.

Systems

Practically all street railway cars found in operation a year or so ago were operating bare lamps, no attempt being made to re-distribute the light or prevent the glare of the filaments. Distribution was obtained by distributing a great number of small units rather than by re-directing the light from a few larger ones. Companies wishing to take immediate advantage of the characteristics of mazda lamps have replaced their carbon lamps, lamp for lamp, with mazda lamps. Of course, this represents a much smaller initial investment and presents an opportunity to immediately test out the new lamp. A better practice, of course, would be to re-wire the cars, using a smaller number of units with proper reflectors. A wiring diagram of a re-equipped car is shown, together with tests of illumination at different stations throughout the car.

It is seen that this illumination, while not only considerably higher than that of carbon lamps originally installed, is very uniform throughout. In this system, alternate lamps only are in the same circuit, so that the failure of one circuit still leaves better illumination than that given by the carbon lamps.

There are a great many varieties of circuits installed in present equipments, such as the joining of two circuits of four lamps each through the headlight, which requires the latter to be double the wattage of the lamps in the interior of the car. Some systems also have lamps of half the wattage in the sign boxes and markers. There is no reason, however, why all these systems cannot be equipped with mazda lamps.

Plans are being prepared for extensions to the London & Lake Erie Railway and Transportation Companies lines, work on which it is said will be begun in the spring.

Toronto Municipal Car Barns

The city of Toronto recently purchased a block of land at the corner of Bracondale and Benson Avenues for car barns, repair shops, etc., and are at present erecting, on one corner of this block, barns having an area of 198 ft. x 40 ft., a brief description of which is given herewith. The barns are divided into 11 bays, 18 ft. x 37 ft. 6 in. (inside clearance), and are constructed of steel framework on cement foundations. The design of the walls is shown in one of the accompanying sketches.

The plan and elevation of the new barns are also shown. The barns are so constructed as to be capable of extension at a minimum cost by addition of more sections. The building at present being constructed will accommodate nine cars.

An inspection pit occupies three 18 ft. bays near the centre of the building, the floor level of the pit being depressed 4 ft. 9 in. below the level of the main floor. This pit covers the whole area of 40 ft. wide by 54 ft. long as shown in the plan, and is not partitioned in any way, the superstructure being upheld by heavy I-beams placed vertically. Between the car tracks the space above the inspection pit is floored with cement slabs resting on the I-beam frame-work. At two convenient points, as shown in the plan, openings are left in this flooring to admit of a workman standing upright and inspecting the side of the running gear of the cars. When not so required these openings are covered with removable sections of wooden flooring.

A repair pit underlies the middle track at the extreme west end of the barns. This is the same depth as the inspection pit, but provision is also made at each side of the car for a convenient inspection of the wheels and other gearing; as shown in the plan an excavation has been made 2 ft. 3 in. wide and 2 ft. deep so that a workman may stand on this ledge and be at a convenient height to inspect the wheels or other equipment which is most conveniently reached from the side of the car. When these side ledges are not in use they are covered over by removable wooden slats resting on the cement on the one side and on the iron rail on the other side.

The floors throughout the barns are of concrete with the exception of the two areas at the side of the repair pit which are covered with maple flooring. A slight grade has been given the floors of the pits to points which connect with drains so that the pits may be kept dry at all times.

The first three bays at the entrance end of the barns will be used also as a washroom for the cars. The floor here is

Elevation and plan of Toronto's new municipal car barns, St. Clair Ave.

also graded slightly so as to obtain proper drainage, as shown in the plan.

At the extreme west end of the barns a section some 25 feet in length has been taken off for offices, stores, etc. It will be seen that the boiler room is loacted in this section, also oil rooms and washrooms. A conductor and motorman's room measuring 25 ft. x 18 ft. occupies, with a store room and the upper part of the boiler room, the second storey of the office compartment.

The roof is tar and gravel covered with a sky-light extending the full length of the building (roof truss figured for concrete slab later). Heating will be by forced air system, the pipes being all run underground. The hot air will be discharged at regular intervals along each side of the building from openings in the floor.

Municipalities Eager For Radials

Prior to his departure for England Hon. Adam Beck was the guest at a banquet in Guelph where some 300 delegates were assembled to discuss the question of an electric radial line connecting Hespeler with Guelph with some point on the Georgian Bay. The exact location of the line has not yet been decided upon, but the commission has been asked to make an investigation and report both on the most suitable route and on the cost of the road.

Great enthusiasm prevailed throughout, the scheme being endorsed by practically every delegate present. The 25 municipalities represented agreed to form themselves into a union to be known as the "Hydro-electric Radial Union of Western Ontario" with the purpose of assisting the commission in any move they may make towards the construction and operation of radial lines in Ontario. The officers elected for this union were as follows:—Hon. Adam Beck, honorary president; J. W. Lyon, president Guelph Radial Railway Company, president; G. B. Ryan, second vice-president; T. J. Hannigan, third vice-president; G. Powell, Hamilton, secretary-treasurer. Vice-presidents were added from twelve districts as follows: H. W. Ironsides, Puslinch; Geo. Forbes, Hespeler; Jos. Rooch, Arthur; A. A. Armstrong Fergus; W. S. Middlebro, M.P., Owen Sound; John Bernie, K.C., Collingwood; Mr. Richardson, Flesherton; S. Bell, Dundalk; Geo. T. Thorp, president of Guelph Board of Trade; Alex Simmers, vice president Guelph Board of Trade; R. J. Ball, Hanover; L. U. Richardson, M.P.P., Elora.

The following resolution was passed unanimously:—"That this meeting, representing some 25 municipalities of the counties of Wellington, Grey and Simcoe and extending from the village of Hespeler through the city of Guelph to various points on the Georgian Bay, which municipalities are vitally interested in an electric railway system through this district and having regard to the great and satisfactory work of the Hydro-electric Commission in the Province of Ontario, realizes that no organization in the Province is better equipped or has better facilities for carrying out such a project. These municipalities, therefore, having long felt the need of reasonable transportation through this district and now realizing that through the passing of the Hydro-electric act of 1913 their great opportunity of securing said electric railway facilities is in sight, and further believing that their interest will be best served by an electric line built and operated by the Hydro-electric Commission, do here and now urge upon the Hon. Adam Beck and his colleagues of said commission that they give these municipalities their kindly assistance in compiling all the necessary information as to cost of construction and operation, method of financing and most suitable location of said line, so that it may serve the best interests of the people of the district. And in return they guarantee them their earnest co-operation and support in the building up of such a Hydro-electric radial system as shall bring the greatest development, progress and prosperity of the whole Province of Ontario.

The Middlesex county council have also indicated their eagerness to co-operate with the Ontario Hydro-electric Power Commission in the construction of radials in their county and the commission will be asked to prepare estimates on three different lines. One of these would connect Stratford with London and the other two would connect Chatham with Grand Bend by different routes, one by way of Lucan, and the other by way of London, Ailsa Craig and Parkhill.

Making a Good Start

The Tillsonburg Electric Car Company, Limited, have just received an order for two interurban cars for the Windsor, Essex & Lake Shore Railway Company to be built according to the following specifications.—seating capacity, 62; length over body, 44 ft.; length over bumpers, 55 ft.; width over all, 9 ft. 1½ in.; interior trim, polished bronze; roof, monitor deck style; bottom frame, composite wood and steel; interior finish, oak; heaters, Peter Smith; couplers, radial.

The same company have recently shipped two cars to the Dominion Power & Transmission Company, Hamilton, Ont., as described hereunder:—length over all, 51 ft.; length over body, 49 ft.; width over all, 9 ft.; interior trim, polished bronze; roof, monitor deck style; bottom frame, composite wood and steel; interior finish, chestnut; couplers, M.C.B.; trucks, Taylor extra heavy with rolled steel wheels.

A public meeting was recently held in Aylmer of representatives of the municipalities interested in the proposed extensions to the London & Lake Erie Railway & Transportation Company's system. It was decided that the different municipalities confer as to the proportion each should pay in guaranteeing the company's bonds. It is said the company will require a guarantee of $20,000 a mile and free right of way, but that under these conditions they are prepared to go ahead with the extensions at once.

General Manager Coleman, of the Hamilton Street Railway Company, is reported to have stated that his company is prepared to lay new tracks on King street from Catharine to Bay streets; on York street, from James to Queen streets; on Margaret street, from King to Main streets; and on Main street, from Margaret to Locke streets, and that the work will probably be commenced early next spring.

The March of Progress

The American consul at Jerusalem advises that companies desiring to compete for the adjudication of a tramway to be constructed at Jerusulam, and for the establishment of an electric-light system for the same city, in accordance with conditions which have been distributed, will have to present their bids to the Commission of Adjudication, which will be constituted at the Conak of the Government at Jerusulam. The concession will be granted for forty years.

New Books

Electric Arc Phenomena—By Ewald Rasch and translated from the German by K. Tornberg; D. Van Nostrand & Co., publishers; price $2.00 net. This book is a general review, with illustrations, covering both the theory and application of electric arcs. Its scope will be fairly understood from the following chapter headings:—(1) General Outline of Electric-arc Phenomena. (2) The Typical Carbon Arc External Phenomena Arc Adjustment. (3) Typical Electrode Materials and Their Physical Properties. (4) The Theory of Electrical Discharges Through Gases. (5) Spark Discharges. Empirical Results. (6) Voltage and Current Conditions in the Arc. (7) Distribution of the Energy in the Arc. (8) Efficiency of Commercial Types of Arc.

The Dealer and Contractor

Electrical Equipment in a Calgary Store

The new store recently opened by the Hudson's Bay Company in Calgary and which is understood to be the first of a group to be established at different points in Canada is equipped with the most modern appliances as to heating, ventilation, refrigeration, illumination, etc. The new store is situated at the southwest corner of Seventh Avenue and First Street West, having a frontage of 250 feet on Seventh Ave. and 130 feet on First Street. The building at present consists of six storeys, but provision has been made for increasing to ten as the development of the business demands it.

The Generating Equipment

The electrical equipment at the present time consists of three 300 kw., 3-wire, d.c. generators, direct connected to a Corliss type 480 h.p. steam engine and it is the intention to install a similar unit for use at off peak hours, with possibly a storage battery. The generators produce current at 230 volts for power apparatus and 115 volts for lighting. The generators were supplied by the Canadian Westinghouse Company and the engines by the International Engineering Works, Amherst, N.S., the boilers were built by Babcock & Wilcox.

The Switchboard

The main switchboard is very completely equipped with instruments. Its dimensions are 27 ft. x 8 ft. 4 inches, blue Vermont marble. Each generator is equipped with two ammeters, a double-pole interlocking circuit-breaker, two double-pole and a single-pole fused switches, a field rheostat and a voltmeter receptacle. On the totalizing panel are mounted an ammeter for registering the total output of the generators equipped with shunts so that it may be used to calibrate the wattmeters; two Thompson astatic type integrating wattmeters, one to record the output for lighting service and the other the output for power service, ground detector lamps, a voltmeter switch, an ammeter switch and a clock connected to the store clock system. The feeder panels are equipped with triple-pole switches for lighting and double-pole switches for power feeders. All fuses are mounted on slate slabs at the rear of the board and every switch and every fuse slab is provided with a copper name plate to identify it. At the left end of the board is a bracket carrying two indicating voltmeters, one reading 0-300 volts, the other 300-0-300 volts. The arrangement of voltmeter plugs and switches is such that the bus-bar voltage and the voltage of the incoming machine may be read simultaneously when paralleling generators. The switchboard was supplied by the Canadian Westinghouse Company.

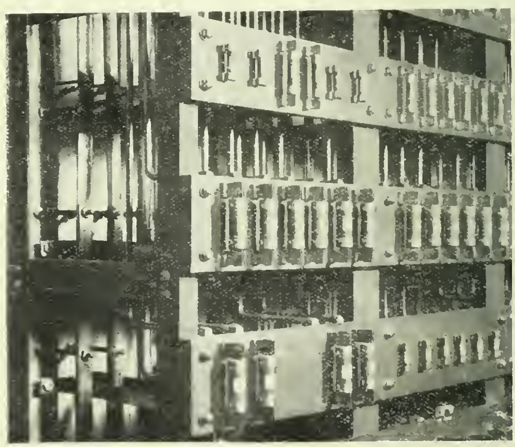
The Illumination

The main floor is lighted by Canadian General Electric triple carbon arc lamps which are mounted in handsome spun brass castings. The globes are of Alba glass. The lamps are suspended from the ceiling by an ornamental brass chain at a distance of 10 ft. 6 in. from the floor. The light is said to be especially suitable for matching fabrics in addition to providing an attractive and pleasing effect. Semi-indirect units are used on the upper floors consisting of 14-inch bowls of Moonstone glass with a highly polished inner surface and a Doric ridged outer surface. These bowls are hung by triple chains and each carries a single 250 watt tungsten. There are two fixtures in each bay of 396 feet area.

The show windows are equipped with Holophane steel reflectors of the poke-bonnet type, each carrying 60 watt tungstens. The fixtures were all manufactured by McDonald & Willson, of Toronto.

Telephones, etc.

A complete telephone installation connected to the Calgary municipal system has been provided. Also an electrically operated system of clocks controlled by a master clock of the mercury compensating pendulum type. A watchman's time detector system has been installed to guard against fire and theft; stations are placed at three points on each floor at each of which the watchmen must register; a battery is used to operate the system. A Gamewell signal system has also been installed. A pneumatic tube for carrying messages and cash to the central point is operated by motor-driven blowers. The refrigeration system is also motor-driven, as is also the ventilation and heating, the latter of which is partly by the indirect method of blowing air over heated coils and partly by the direct method of steam radiators.



Small section of rear of Switchboard.

Motor Equipment

One gets a fair idea of the value of the electric motor in a public building of this sort by the following complete list

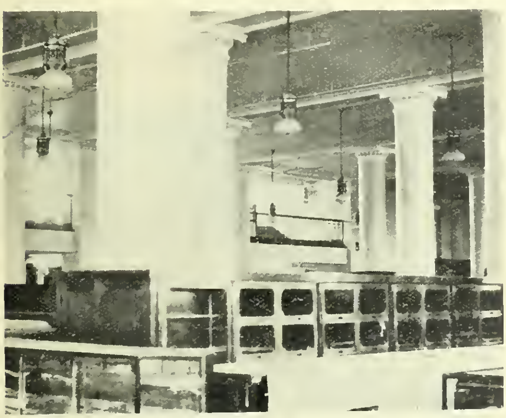
which gives the size of each motor and the use to which it is put.

4 35 h.p. for passenger elevator machines.
1 35-h.p. for employes' elevator machine.
2 35-h.p. for freight elevator machines.
2 7½-h.p. for main blowers, vent. rooms Nos. 2 and 3.
1 5-h.p. for main blowers vent. room No. 1.
3 7½-h.p. for vestibule blowers, vent. rooms Nos. 1, 2 and 3.
3 2½-h.p. for air washer pumps, vent. rooms Nos. 1, 2 and 3.
1 12-h.p. for exhaust fan for main floor.
1 12-h.p. for exhaust fan for boiler and pump rooms.
2 2½-h.p. for exhaust fan for shipping room.
1 5-h.p. for exhaust fan for engine room.
1 3-h.p. for exhaust fan for toilet rooms, 3rd and 4th floors.
5 ¼-h.p. for exhaust fan for small toilet rooms.
1 5-h.p. for exhaust fan for kitchen.
1 5-h.p. for exhaust fan for restaurant and cafeteria.
1 ¼-h.p. for exhaust fan for bakeroom.
1 10-h.p. for vacuum cleaner machine.
1 15-h.p. for house pump.
1 7½-h.p. for well pump.
1 7½-h.p. for brine pump.
1 3-h.p. for drinking water pump.
1 20-h.p. for large sump pump.
1 3-h.p. for small sump pump.
2 7½-h.p. for cash blowers.
1 1¼-h.p. for parcel belt conveyor.
2 ½-h.p. for motor generator sets.

The Electric Wiring

Perhaps the most interesting feature of the electrical installation from the contractor's point of view is the wiring and switching arrangement and the following complete description will be of interest.

From the switches on the feeder panels of the main switchboard in the engine room the feeders are taken up into a large sheet-iron junction box, which is mounted directly over the switchboard and extends its full length. This arrangement admits of changes being easily made in the feeder connections. From this junction box two-wire feeders for power are carried to the various fan rooms, elevator machine rooms and to the various electric motors in the engine and pump rooms.



Illumination of main floor.

The lighting on each of the upper floors is controlled from four panels located on the south side of the floor. These panels are built of black slate and provided with three-wire bus-bars with two-wire branch circuits, each controlled by a push-button switch.

An interesting feature of these panels is their arrangement with two sets of bus-bars. A limited number of lights is controlled from the smaller set of bus bars, for use at night when the floors are being cleaned. Each of the four tiers of panels, from the second to the sixth floors, inclusive, is controlled by two sets of feeders, one for the night bus bars and one for the day bus-bars, so that at night time the unnecessary waste of energy for light may be prevented by the opening of the switches controlling the "day feeders" at the switchboard. During business hours both night and day circuits are in use. The lighting of the main floor is controlled by four panels similarly arranged with double sets of bus-bars and each provided with separate feeders from the switchboard. A panel for controlling the lighting of the pent houses is located in one of the pent houses. An additional panel for controlling the roof standards, and provided with its own feeder direct from the switchboard, is located in a pent house. A panel for controlling the lights in the shipping room and one for controlling the lights in the boiler, engine and pump rooms are located in the basement. Here is also located a separate panel for controlling all the lights in the stair halls, in front of the passenger elevators, in the freight vestibules and in the elevator cars. The lights at these points are connected in vertical rows so as to insure, as far as possible, light at these points even if one circuit is temporarily out of commission.

The lighting of the show windows and marquises is controlled from five special panels located on the main floor and directly controlled from the switchboard. These panels are arranged with three sets of bus-bars. Two of these feed alternate lights in the show windows and one the receptacles in these windows. In the show window panels near the entrance two additional sets of bus-bars are provided to supply the lights in the marquises. One of these panels is provided for each group of show windows. Each set of bus-bars is controlled by a three-pole knife switch. The branch circuits have enclosed fuses, but no switches. In addition to the ceiling outlets for lighting fixtures, base receptacles have been installed at all columns, and, on the first, second and third floors, floor receptacles for the purpose of illuminating the display cases and counters. Each fixture is provided with a push-button switch, placed in a pocket in the fixture.

For supply power for sewing machines, electric irons and other purposes in the work rooms two sets of feeders are installed, one at the east end of the building and one at the west end. The panels in the work rooms are arranged with three-wire bus-bars and provided with one 25 ampere switch for power at 230 volts, two for irons at 115 volts and four for lighting over the work tables at 115 volts.

L. K. Comstock and Company were the general contractors for the complete electrical and mechanical equipment the contract including furnishing and installing boilers, power piping, heating, engines, generators, switchboard, complete wiring for lighting, power and low tension work, sprinkler system, plumbing, pneumatic cash tube system, refrigeration, etc.

Collecting Accounts

From the honeyed letter to the blunt sheriff's officer there are many ways of trying to collect accounts and Mr Burt gives some good suggestions in the current issue of the National Electrical Contractor. Mr Burt strongly advises that no stereotyped letter can be made to fit all cases. He is also a believer in following up accounts promptly, preferably by personal calls, but if this is not possible then by pointed letters. The article, in part, follows:—

"The writer has been engaged in collecting commercial accounts for several years, but has never yet found an iron ribbed letter that would always bring results—or even an

answer. If I could find such a writing, my future would be a life of luxury and fortune. However, I do not condemn these books or their forms.

My experience in the collection business has taught me that even the best of letters, whether copied or original or both, should not be used if a personal interview with the debtor is possible. My experience has taught me other things, too, and I give below a short set of rules which seem to me most important to be observed when making collections:

First. The early bird catches the money worm. When your account is due, collect it.

Second. Never write a collection letter when it is convenient to make personal solicitation. It is easier to throw a typewritten sheet into the paper basket than one's creditor into the street. If you cannot go yourself, send a clerk. And if at first you don't succeed, stick around. Creditors are embarrassing, and persistence wins.

Third. If you must of necessity write a collection letter, write it to the point. Do not hesitate to state the purpose of the letter directly and firmly, but politely.

Fourth. Do not write excuses in your collection letters. If the account is due, you have a right to collect it. An excuse for your wanting it gives the debtor an opportunity for an excuse for not paying it. If you write that you have obligations to meet and therefore must have your money, he will reply that he likewise has obligations and he must have your money.

Fifth. After you write a collection letter, be honest with your debtor and do exactly as that letter says you will. If your letter says you will sue, sue. A business man comes to be known by his threats to his debtors. If you want their respect, keep your threats. This means being honest with your debtor—and yourself.

As I stated before, there is no one letter that will serve every collection purpose. There is no one letter that will have the effect upon every debtor-recipient's mind that you wish it to have. I suggest below three forms of letters for ordinary commercial accounts, to be altered for each different collection so as to present the correct facts. I do not offer them only as a panacea for collection ills. I offer them only as a basis upon which other letters may be built and perhaps successfully used.

When an account is overdue it might be called to the debtor's attention in this way:

Joe Doe,

99 Hoe Street, Moeville, Pa.

Dear Mr. Doe:

You have doubtless overlooked the payment of your October account. Kindly favor me with a prompt remittance of the amount due—$99.00.

Very truly yours,

Ten days after letter No. 1 goes forth, you might try this one, providing no payment had been made in the mean time:

Dear Mr. Doe:

Ten days ago I called your attention to the fact that your October account had not been paid, and asked you for a prompt remittance. No response to that request has been received by me. This account is now considerably overdue. Please forward payment thereof immediately.

Very truly yours,

In case Mr. Doe continues obstinate I should suggest this:

Dear Mr. Doe:

Please let me have payment of your October account before December first. Unless it is paid before that date I shall hand it to my attorney for collection.

Very truly yours,

And I should sue."

Conduit Work in a Fireproof Building

One of the most difficult problems encountered in designing the electrical work in buildings of certain classes is that of selecting the best locations for the ceiling outlets. And after the best that is possible along this line has been done it is often necessary, when the building is ready for occupancy, to add new outlets or to change the locations of some of those already installed. Moreover, such revisions of the wiring are quite liable to be troublesome to make in a manner that is satisfactory. To take a specific example, consider the modern type of fireproof office building. The requirements of the tenants on any floor of such a building can hardly ever be fully anticipated while the wiring is being done; the work can only be laid out to meet their probable needs, and then when the arrangement of the offices is definitely known, important changes in the location of the ceiling outlets may be found to be desirable. Thus, at best, it becomes necessary to do more or less of objectionable cutting and patching in the ceiling. This process is expensive, and if the work is not done by skilled workmen the ceiling structure may even be materially weakened.

Having realized the foregoing difficulties, from experience in the construction field, a firm of electrical contractors in Chicago developed a new and very interesting system of concealed conduit construction, not long ago, the principal object of which is to provide new lighting outlets in a building without the necessity of resorting to any objectionable cutting of ceilings and floors and the consequent patching of the plaster. The first installation of this kind is now being completed in one of the large fireproof office buildings in Chicago.

Characteristic features of the construction under consideration consist in the fact that the conduits for the accommodation of the ceiling outlets are placed in the ceiling just above the plaster, and that, by means of a tool designed for the purpose, an outlet can be readily installed at any point in a run of conduit after the ceiling is finished, without

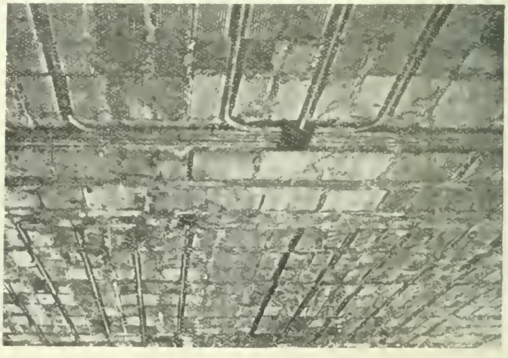


Fig. 1.—Showing portion of ceiling before plastering.

the necessity of cutting a hole in the plaster larger than can be covered with a fixture canopy of the usual size. In fact, ceiling-outlet boxes will not be installed on any part of the job until the space on the various floors is rented and the tenants specify where the outlets are wanted.

The Webster Building, in which the system is being installed, is a 12-story-and-basement fireproof structure with tile floor arches. The National Fire Proofing Company made a special grooved tile block and soffit tile for this building, the cost of which, it is claimed, was no greater than that of standard tile. In one or two instances when the tile setters ran out of the ordinary tile, the conduit was spaced to set

in the seam between the arches, which demonstrated that this method is also practical, though not so desirable as the special tile.

The conduit was installed 13 inches center to center, almost throughout the ceilings (which is the maximum Universal layout), and was laid on the centering, or temporary planking, used by the fireproofing. The conduit hangers, which hook around the pipe and clamp to the flanges of the I-beam, were then set in place and locked up tight, securely holding the conduits in their exact positions. One end of each conduit run was closed with a gas cap, and the other end terminated in a small junction box. With only two exceptions on each floor, each junction box was the terminal for one end of each run in two adjoining offices. These boxes are approximately 6 by 8 inches, and are provided with a plaster cover with a 4-inch round opening in the center. This is all concealed, as are the conduits, by the plaster. A round flat cover is provided for the opening in the plaster cover, which is drilled for screws and countersunk so that when installed it protrudes only the thickness of the metal below the finished ceiling. When painted over this cover is not noticeable, though as a hand-hole it allows access to the wires and connections from all conduits terminating therein.

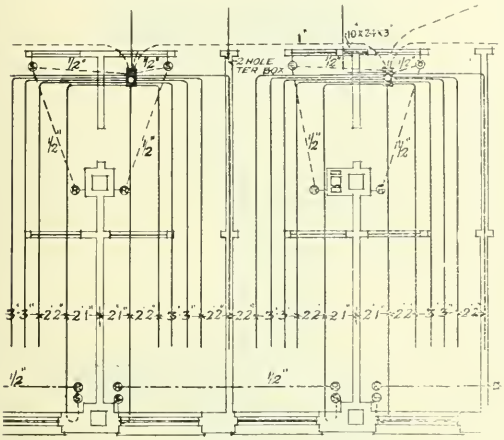


Fig. 2 —Plan of conduit construction.

These boxes and conduits are flush with the bottom of the tile and are concealed only by the plaster. The home-runs from the junction boxes to the panel cabinet are one-inch conduits over the top of the tile, as is present practice. For greater flexibility all junction boxes are interconnected with one-inch conduits; an idea of this flexibility may be obtained from the fact that a switch in the northeast corner of the floor can be connected to a fixture in the southwest corner without touching the plaster. The junction boxes replaced troughs which it was originally intended to use.

Switches and receptacles are being installed in columns and outside walls only, where they cannot be covered by future partitions.

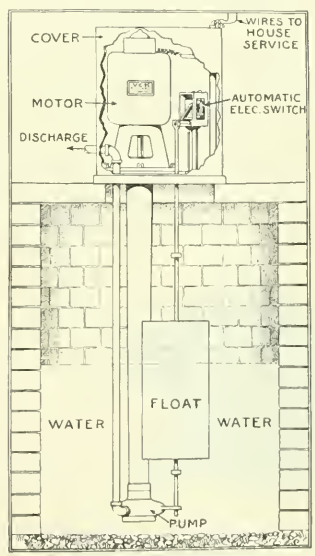
A valuable feature made possible by this system as installed in this building is that all receptacle outlets to outside walls are connected with half-inch conduit. This allows the installing of a receptacle anywhere on this pipe at any time during the life of the building. All switch legs terminate in the junction boxes, and at this point may be connected to any or all conduits in the room.

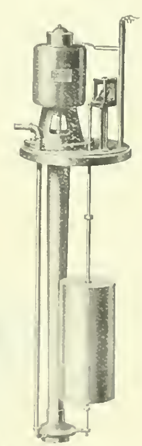
Fig. 1 shows portions of the ceiling before the plastering was done. The method of running the conduits from the junction boxes is brought out very clearly. Fig. 2 is a working drawing of the conduit construction in a portion of the ceiling. Dotted lines show how the junction boxes are interconnected, while the dotted line extending to the right from the junction box in the upper right-hand corner of the figure indicates the circuit from the wire shaft containing the risers from the service board in the basement.

Outlets will be provided by milling out the lower half of the conduit with a special milling machine and fastening a conduit-outlet box to the pipe with U-bolts, the box and bolts being of special design. It is claimed that the conduit can be milled out without disturbing the conductors and that no rough edge or burr will be left at the opening to injure the insulation.—Electrical Review.

Automatic Electric Cellar Drainer

Those who are troubled with wet cellars or basements will appreciate the value of the automatic electric cellar drainer illustrated herewith. This device, it is claimed, is the first practical drainer of moderate price suitable for private residences, apartments, elevator pits, etc. As shown by the diagram it consists of a centrifugal pump direct connected to a vertical Westinghouse motor. The pump is installed in a three-foot well into which the seepage drains, the motor and control apparatus being at the floor level where it is accessible for inspection and is out of the way of dampness. A float plays between between two stops on a vertical rod that is connected with the motor control switch. When the water in the well rises sufficiently to cause the float to press against the upper stop, the motor is started and continues in operation until the water level is lowered so that the float presses





Motor-driven pump for draining purposes.

against the lower stop, when the current is cut off. The seepage is thus cut off without attention, an occasional inspection and lubrication being all that is required. This pump has a capacity of 500 gallons per hour against a head of 5 feet, and 150 gallons per hour against a head of 20 feet. To install it all that is necessary is to provide a well three feet deep, place the pump, and make the electrical connections. It operates from the electric lighting circuit. The Vaile-Kimes Company, Dayton, O., manufactures the outfit.

A Prosperous Business

The firm of John Starr Son & Company have just moved into their new fine building on Grenville Street, Halifax, N.S. This is a handsome four-storey stone building 23 ft. x 66 ft. with basement, finished in hardwood and fitted with modern offices, showrooms and storage facilities.

It is interesting to note that this firm represents the oldest electrical supply house in Canada. As far back as 1880 Mr. Starr established the business in a small way, from an electrical point of view, as may be understood when we remember that at that time the incandescent electric lamp was unknown and the electric motor had not come into commercial use. In the mean time the firm has grown with the electrical business and recently they have had in charge some of the largest electrical installations in the East. At the present time this firm is installing the complete electrical equipment of the Woodside Sugar Refinery, Halifax, where in addition to other electrical requirements there will be nearly 200 motors installed, every machine in the refinery being electrically driven.

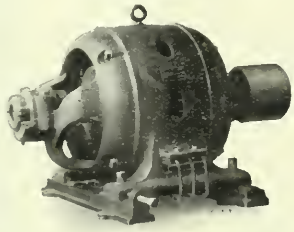
Some four years ago the founder of the firm, Mr. John Starr, died and was succeeded by Mr. Chas. C. Starr as president and managing director. Mr. J. H. Lockhart is engineer and sales manager of the company and Mr. J. T. Dorey secretary-treasurer.

A Self-Starting Polyphase Motor

The Wagner Electric Manufacturing Company of St. Louis, Mo., have placed on the market a polyphase motor that is self-starting under full load by merely closing the service switch. As the current taken at the instant of starting is not more than that taken by the usual polyphase motor with a starting box, there is no objection to its use in sizes up to 50 h.p. on central station lines.

The stator or field of this motor has the usual polyphase winding. The rotor, or armature, is exactly similar to the rotor of the single-phase motor originated by this company. At starting, the coils are connected in a series parallel arrangement giving the motor high resistance rotor characteristics. When about three-quarter speed has been attained all coils are short-circuited by a centrifugal mechanism, after which the rotor operates as a squirrel cage induction motor.

This motor is particularly adapted to remote control ser-



vice and can be located at a considerable distance from the control switch. If the service should fail the motor will stop with connections made for automatically starting. It is not necessary for an attendant to make a trip a quarter or a half-mile to start the motor when service is restored. For automatic control by float switch, pressure switch, etc., this motor can be used to excellent advantage, saving the expense of complicated and expensive starting switches that are usually necessary when ordinary types of polyphase motors are used. A twenty-five horse-power motor of this type is shown in the illustration.

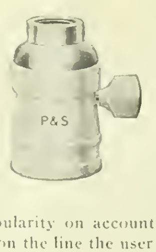
New Electric Water Heater

A 660-watt electric water heater of new design has been added to the line of water heaters made by the Cutler-Hammer Manufacturing Company. This new heater, illustrated herewith, has a water capacity of three quarts and because of its low consumption of current it can be attached to almost any lighting circuit. For the purpose of guarding against waste of current a small pilot lamp is mounted in the base of the heater, under a ruby glass lens, this serving as a signal light to show when the current is on, and as a reminder to switch it off when the heater is no longer required.

A flush switch is mounted in the base, the two buttons of which facilitate the operation of switching on and off the current. These heaters are of special value in the cooler months in buffets, restaurants and drug stores where they can be used in dispensing hot drinks at the counter or for furnishing hot water for any purpose. In the home they are suitable for furnishing hot water almost instantly for tea, coffee, cocoa or other hot drinks, soups, broths, for the shaving mug or for any other purpose for which hot water in small quantities is wanted quickly. The frosted glass globe is decorated with cut glass stars and the base is heavily nickel plated. The heating unit is a new type and can be readily renewed.

A New Lamp Socket

The accompanying illustration represents the latest addition made by Pass & Seymour to their interchangeable porcelain sockets. These interchangeable sockets are claimed to



be growing in popularity on account of the fact that in the event of a ground on the line the user is protected by a porcelain shell. This new unit is supplied complete as shown with a one-half inch aluminium cap.

Water-Tight Condulets

The accompanying illustration is representative of the type PR series of condulet, manufactured by the Crouse-Hinds Company of Canada, which are for use where durable water-tight junction boxes of medium size are required, as in railroad yards and shops. They are also suitable for underneath or overhead car wiring installations. The hubs on these condulets are so designed as to insure a clearance of at least three-quarters of an inch between the surfaces wired over and the conduit. These condulets, where used on car roofs, give no

opportunity for the accumulation of cinders—a feature which prevents the otherwise rapid deterioration of the roof covering along the conduit and around the condulet. The cover overhangs the condulet body and is held in place by four heavy brass cap screws. The joint is made water-tight by a gasket. The bottom of the condulet is reinforced at the centre, to allow drilling and tapping for an extra conduit or for the suspension of a centre lamp fixture of pedestal design.

Midas Mystery Platform

The Midas Mystery Platform is one of the latest display window advertising novelties. It consists of an ebony case, the top of which is formed by a mirror. On this mirror rests a velvet pad or "platform," which carries the article to be advertised. The "platform" moves about on top of the mirror in a most mysterious fashion, there being apparently no means whereby this motion could be caused as every part

of the unbroken mirror surface can be seen at one time or another. In this way the observer's attention is drawn directly to the article being advertised. How is it done? Frankly we don't know as the manufacturer won't tell us. The only hint he drops is that a 1/20 h.p. Westinghouse motor is at the bottom of the mystery. This device is made by the Mercantile Advertising Company, New York.

An electric railway line connecting Battleford with North Battleford is being promoted. It is probable that a by-law will be submitted in the near future.

Insulating Type Couplings

The cuts herewith represent something new in electric hardware. These insulating type couplings, known to the fixture trade as insulation joints, were originally made of cast iron or brass and later of malleable iron. A type of joint is now being produced in which drawn steel is used exclusively. Fig. 1 represents a drawn steel shell inwardly flanged and corrugated to give a grip on pipe tongs or wrench. Fig. 2 shows a drawn steel thimble consisting of a threaded cap


Fig. 1.

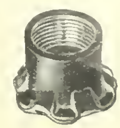


Fig. 2.

with a "pie crust" fluted flange. This joint complies with the underwriters' requirements that insulating joints used on electric and combination fixtures should have double insulation and should stand a test at either end of 4,000 volts, alternating current, for five minutes. The insulation is of the nature of artificial stone moulded in place and subsequently hardened and has been given the name Di-el-ite. This is a product of the Wirt Company, Philadelphia, who also manufacture the above special joint.

Portable Sub-station for a Coal Mine

The Berwind-White Coal Mining Company, Windber, Pa., have recently added a 400 kilowatt Westinghouse portable sub-station to their equipment and are making a very interesting use of it. The sub-station consists of apparatus for changing alternating current into direct current, and is generally necessary in mining work because direct current must be used for haulage in mines but cannot be transmitted economically over long distances. Hence, when the mine is located some distance away from the power station that serves it electric power can be transmitted more efficiently as alternating current at a high voltage and then transformed to direct current in the sub-station.

The Berwind-White Company are developing these outlying properties very rapidly and need direct current at points where permanent sub-stations are not yet erected. In order to prevent delays in the development the use of a portable sub-station was decided on. This sub-station has the same equipment that a permanent installation has; namely, transformers to step down to a moderate value the high voltage of the current received from the transmission line, a switchboard, and a rotary converter, which receives alternating current and delivers direct current. This apparatus is mounted in a car resembling an ordinary freight car.

When the work at a new development reaches the point where direct current is necessary the portable sub-station is hauled out to the workings, connected to the alternating current transmission system, and started to work generating direct current. When the permanent sub-station is built the portable one becomes unnecessary and is taken to the next development. A further use of this sub-station is to provide insurance against shut-downs. If accidents occur at any of the permanent sub-stations, the portable outfit is sent to carry the load until repairs are completed. One portable sub-station, therefore, is practically the equivalent of a duplicate set of apparatus at each permanent sub-station.

Current News and Notes

Birtle, Man.

A by-law was submitted on December 16 to authorize the expenditure of $3,000 on a telephone system.

Brantford, Ont.

It is expected that the street lighting system will be ready for operation by January 15 and that domestic and commercial lighting can be attended to by February 1.

Collingwood, Ont.

The Imperial Steel & Wire Company have awarded a contract to the Canadian Westinghouse Company for motors, transformers and other electrical equipment required in their new factory.

Camrose, B.C.

The town council have decided to supply free power for verandah lights as a satisfactory means of illuminating the streets.

Cote St. Paul, P.Q.

In order to secure a greater quantity of power, the Department of Railways and Canals are constructing a new power house at Cote St. Paul on the Lachine Canal, P.Q. At present there are two power houses on the canal; one will now be abandoned, and the new one built near the site of the second. The power is utilized for lighting the waterway and for opening and closing the dock gates. The new building will be 70 ft. x 70 ft., and the structure will be a one-storey one. New generating equipment will be installed, consisting of four turbine wheels 60 in. in diameter; one turbine wheel 36 in. in diameter, two exciter wheels five generators, and two transformers. The head of water is 8 ft. 6 in. The equipment will be capable of generating a total of 650 horse power.

Donnacona, P.Q.

The Quebec Government has sold its channel rights on the Jacques Cartier River to the Donnacona Paper Company for $1,000 on condition that the company spend $100,000 within four years for improving the hydraulic power.

The Ambursen Hydraulic Construction Company of Canada, Limited, Montreal, are suing the Donnacona Paper Company, P.Q., for some $100,000 in connection with a contract for building a dam for power purposes. It is claimed that the plaintiffs contracted to build the dam upon a percentage basis, and that the defendants stopped the work.

Edmonton, Alta.

The Macdonald Hotel in Edmonton to be built by the Grand Trunk Pacific Railway Company, will probably be supplied with light and power from its own generating plant.

A number of private companies are said to be preparing offers to supply electric power to the city at a lower rate than it can be supplied by the municipal plant. One of these at least proposes to develop power at a nearby coal mine and transmit the power at high tension to Edmonton. In the Wabamun district, 40 miles west of Edmonton, there is said to be 60,000,000 tons of lignite coal easily available and indeed it is pretty generally understood that the whole of Alberta is practically underlaid with lignite.

Fredericton, N.B.

The Eel River Light, Heat & Power Company, who have a site capable of developing some 4,000 h.p. of hydro-electric energy have made an offer to Fredericton to supply them with energy for light and power purposes on a meter basis of 2c per kw.h.

Fort William, Ont.

A by-law will be submitted on January 5 authorizing $125,000 expenditure on telephones and $115,000 on electric light and power extensions.

For the year ended 31st October last the earnings of the Kamistiquia Power Company were $302,741, an increase of $58,855. Operating expenses were only $8,414 higher, leaving a net revenue of $262,638 as against $212,197 last year. The balance evailable for dividends was $180,039, an increase of $50,843, or about 40 per cent. This is equivalent to 9 per cent. earned on the $2,000,000 stock. The surplus after charges and dividends amounted to $45,039, as compared with $14,796 for the previous year. This increase is shown despite the fact that dividends at the rate of 5 per cent. were paid during the year, an increase of 1 per cent. over 1912. Owing to the increased demand for hydro-electric power, the company will enlarge their plant by the installation of an additional 12,000 horse power unit. This should be ready for operation by next July. To meet the cost of this construction, an additional $200,000 of stock will be issued in the near future.

Galt, Ont.

The Galt, Preston & Hespeler Railway Company are installing transformers and a new rotary converter which will approximately double their present power capacity.

Gananoque, Ont.

The new lighting system of this town installed by the Gananoque Electric Light & Power Company, Mr. J. M. Campbell, superintendent, was recently placed in operation in one of the wards. It is expected that the service will be inaugurated in other sections of the town very shortly.

Goderich, Ont.

It is expected that hydro power will be in operation in this town by January 1.

Grand Falls, B.C.

Telephone connection between Grand Falls and the Western Pine Lumber Company's camp, 28 miles north of this city, has been established on the new line being built by the Forestry Department. The wire is strung about seven miles further and it is expected to be completed to Franklin camp in about a fortnight.

Hamilton, Ont.

The Fire Underwriters' Association have advised the duplication of the present pumping equipment in Hamilton.

The Bell Telephone Company moved into their new building on December 14. The cut-over was completed without causing any delay to the service.

The Toronto, Hamilton and Buffalo Railway Company have practically completed the installation of their automatic block signal system, electrically operated, between Hamilton and Welland.

Lacombe, Alta.

The municipality of the town of Lacombe will, in the near future, install an engine type 277 r.p.m., 100 kw., 3-

phase, 60 cycle, 2500 volt generator complete with field rheostats and pulley from which to belt an exciter. Mr. E. J. Tett is secretary-treasurer and commissioner.

Le Pas, Man.

The municipality of Le Pas are at present installing a 240 h.p. Diesel engine direct connected to a 200 kv.a. generator. The engine was supplied by the Boving Company of Canada, and the generator and exciter by the Canadian Westinghouse Company. The switchboard and switching equipment and the street lighting system are being supplied by the Canadian General Electric Company and the necessary transformers by the Canadian Moloney Electric Company. The plant is being installed by Murphy & Underwood, consulting engineers, Saskatoon, under the immediate supervision of Mr. R. A. McLellan as resident engineer.

A by-law was passed on Dec. 16 authorizing the issue of debentures to cover the cost of the electric plant which is being installed.

Montmorency Falls, Que.

The Dominion Textile Company are making considerable extensions to their plant here. The new extensions will be entirely driven by electricity.

Montreal, Que.

Tenders will be received up to December 30 by the Board of Commissioners for lighting fixtures for the city hall annex.

The Montreal Tramways Company have opened a new belt line in Westmount, joining the upper and lower levels of that city.

Mr. H. S. Holt, president of the Montreal Light, Heat and Power Company, is a patient in the Royal Victoria Hospital, suffering from scarlet fever.

The late Mr. James Ross, of Montreal, whose estate for $14,316,256 has been entered for probate, was a holder of 529 Canadian General Electric shares, 1,844 Electrical Development shares, 5,080 Brazilian Traction, Light and Power shares, and 2,000 Montreal Light, Heat and Power shares; he also owned bonds to the value of $138,750, in the Mexican Electric Light Company, and $49,500 in the Rio Janiero Light Company.

Morrisburg, Ont.

The corporation of the town of Morrisburg has entered action for the return to it of the power plant now being used by the Hydro-electric Power Commission of Ontario to supply power for distribution at certain points in eastern Ontario. This plant was originally owned and operated by the municipality but in April, 1912, was handed over to Mr. J. L. Sharkey who undertook to open a sheet steel factory and operate certain other industrial enterprises as well as supply the town with light. Mr. Sharkey failed to live up to his agreement and instead handed his plant over to the Hydro-electric Power Commission.

Nelson, B.C.

By-laws will be submitted at the January elections authorizing the raising of $30,000 to pay debts and provide for improvements on the street railway system.

Neepawa, Man.

Orders have been placed for the following apparatus for the town of Neepawa by their consulting engineers, W. E. Skinner, Limited: With the Goldie & McCulloch Company, of Galt, Ont., for two 72 x 18 return tubular boilers and one 12 x 19 x 8 vertical compound condensing engine operating at 450 r.p.m.; and with the Canadian General Electric Company for one ATB, 150 kv.a., 450 r.p.m., 2400 volt, 3-phase, 60 cycle, a.c. generator.

North Toronto, Ont.

Messrs. A. T. & W. J. Thompson will erect a two-storey planing mill and will operate the machinery by electric power.

Ottawa, Ont.

The directors of the Ottawa Light, Heat and Power Company are issuing $700,000 new capital stock for development work in connection with both their gas and electric subsidiaries.

Tenders are called by the Department of Works of the Dominion Government up to January 15 for 10 knots of gutta percha cable with four conductors and 14 knots of two conductor cable, to be delivered at Halifax May 1, 1914.

The new rates which go into effect January 1 are as follows: Domestic lighting 4c per 100 square feet plus 2½c per kw.h. with 20 per cent. reduction; commercial lighting, 6c per kw.h. for the first 30 hours use and 2½c per kw.h. for all additional with 20 per cent. discount; power, a service charge of $1.00 per month per h.p. of connected load or maximum demand plus a graded consumption from 1.8c per kw.h. down, depending on the quantity, the discount depending on the class to which the consumer belongs.

Peterboro, Ont.

At a recent meeting of the city council the franchise of the Otonabee Light & Power Company was cancelled. This will mean that after January 1, 1914, the customers of this company will not be supplied with light or power until such time as the hydro-electric system is installed.

Mr. A. B. Colville, vice-president of the Peterboro Light and Power Company has offered to continue to supply power and light to Peterboro at the old rate until such time the city can arrange to attend to this supply itself.

The new street lighting system, consisting of magnetite lamps, has been completed by the Hydro-electric Commission and power to operate them will be supplied temporarily, at least, by the Peterboro Light & Power Company.

Plessisville, Que.

The electric line connecting Plessisville with the Shawinigan Water & Power Company's lines has been completed and it is expected light and power will be available by the new year.

Port Arthur, Ont.

A by-law will be submitted on January 5 authorizing the expenditure of $8,000 in electric light extensions.

Preston, Ont.

A by-law will be submitted on January 15 authorizing the renewal of the franchise of the Galt, Preston & Hespeler Railway Company for 25 years with power to make certain extensions and improvements.

Quebec, Que.

The Merchants Light, Heat & Power Company have submitted to the local legislature a by-law to amend their charter by increasing their capital from $800,000 to $3,000,000.

Regina, Sask.

The Grand Trunk Pacific Hotel, the Qu'Appelle, to be erected in Regina, will be supplied with light and power from an isolated power plant which will also supply the railway station located near the hotel.

The operating returns of the municipal street railway system for the week ending December 6 were as follows — revenue $4,423; passengers carried 105,007; passengers car-

ried including transfers 119,746. Corresponding figures for week ending December 13 were: $3,998.25, 96,460 and 110,296.

Richmond Hill, Ont.

A by-law will be submitted on January 5 authorizing the expenditure of $4,000 on electric light extensions.

Sault Ste. Marie, Ont.

A meeting of the International Joint Commission will be held in Washington beginning January 13, to consider the application of the Michigan Northern Power Company for authority to build a dam for power purposes at Sault Ste. Marie; also the application of the Greater Winnipeg Water District to divert water from Shoal Lake, west of the Lake of the Woods, for the purposes of a water supply for the city of Winnipeg.

Souris, Man.

The contract has been awarded to the Brandon Machine & Implement Works for the supply of lighting standards for the street illumination of Souris. These will consist of 13 five-light, 24 4-light, and 28 two-light standards. The order also includes 105 goose necks. The two and four-light standards are of the same design as the five-light with openings so that at any time the additional arms may be added. The five-light standards will be wired underground and the four and two-light overhead; for this latter purpose the company are making a three-inch pipe to slip inside the 3½-inch pipe in concrete with cross arm carrying wires at top.

South Vancouver, B.C.

The Board of Works has authorized the installation of a Gamewell fire alarm system.

Stonewall, Man.

This town was lighted by electric light for the first time in its history on December 12. Power is supplied by the Winnipeg Electric Railway Company.

St. Catharines, Ont.

Negotiations are proceeding between the city and the N. S. & T. Ry. Co. for the construction of a spur track on Welland Ave. to serve the Steel & Radiation Company.

St. John, N.B.

It is officially stated that the Grand Falls Company, Limited, will soon commence work on the erection of large pulp and paper mills at Grand Falls, on the St. John River, N.B. A large amount of power can be developed and transmitted to the towns and villages along the river. Sir William Van Horne is interested in the enterprise. Various schemes for the development of the falls have been proposed, but nothing practical was done until the present company took up the question. Engineers have been at work on the plans for several months.

St. Johns, P.Q.

The St. Johns Electric Company are installing a new electric lighting system on the streets, the supplies for which have just been received.

Tilbury, Ont.

A by-law will be submitted on January 5 authorizing the expenditure of $10,000 on an electric distribution plant.

Toronto, Ont.

The premises of the National Trust Company are being equipped with the Holmes Electric Protection Company's fire alarm and watchman's signal system.

A by law will be submitted on January 1 authorizing the raising of $89,393, by the issue of debentures, to acquire a portion of the Mimico division of the Toronto & York Radial Railway Company's system.

City Solicitor Johnson has reported to the Board of Control that the only companies holding rights to enter the city by underground are the Hamilton Radial Electric Railway Company and the Hamilton, Waterloo & Guelph Railway Company.

The Forest Hill Electric Railway Company is said to be making ready to commence work on their line early in the spring. The first section of the road to be constructed, it is understood, will be from the city limits along Forest Hill Road to Eglinton Ave. and along Eglinton Ave. west.

Verdun, P.Q.

Under the bill of the city of Verdun, P.Q., introduced into the Quebec Legislature, power is given to construct conduits for telephone, telegraph, electric light and other wires. The bill also provides that no person or company shall erect poles in the streets for the purpose of stringing wires on them where a conduit has been built, and the city itself is not to have any such right, and neither can it grant any such permission except for poles for street lighting and for fire alarm wires. All persons or companies using the conduits will have to pay a tax to cover the cost of maintenance and interest charges. To carry out the scheme, power is asked to borrow $500,000.

Welland, Ont.

A by-law will be submitted at the January elections to raise funds for the installation of a fire alarm system. Estimates call for about $5,000.

Westmount, P.Q.

For the year ended October 31st the electric light department of Westmount, P.Q., showed a profit of $23,994, after deducting interest, sinking fund and depreciation of property. This profit has been spent on improvements, including a conduit and new lights on Western Avenue. The year, according to Mr. Grafftey, chairman of the committee, has been a most successful one in every way, chiefly due to the efforts of those employed in the department.

Winchester, Ont.

The village of Winchester is now being supplied with power and light by the Hydro-electric Power Commission of Ontario and in the near future it is expected that Chesterville, Williamsburg and Winchester Springs will be reached by the Commission's lines. At least one township has petitioned the Commission for light and power supplies for the farmers.

Winnipeg, Man.

A by-law was passed on December 12 authorizing the expenditure of $1,000,000 for extensions of their municipal hydro-electric system.

A contract for copper wire required by the municipal hydro-electric system has been awarded to the Eugene F. Phillips Company.

Commissioner Robson has issued a statement covering the financial condition of the municipal hydro-electric system up to date October 31, 1913. As published in our December 15 issue the deficit on April 30, 1913, was $142,274.64. To this is now added the deficit of the next six months of $24,713.94 making a total deficit at October 31, 1913, of $166,988.58. This is after making all the necessary allowances for depreciation, sinking fund and interest on floating debts.

Electrical News
Generation, Transmission and Application of Electricity

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General Review of Progress

In this issue we print our annual review of electrical developments, along both engineering and commercial lines, for the past twelve months. It can not be claimed that this report covers developments except in a general way, but it is yet sufficiently detailed to show that the industry is making rapid strides in refinements of manufacture and generality of application. Very marked advances have been made in railway work, in illumination and in electric vehicles, the latter of which, for many classes of heavy work, are now recognized as being superior to either horse-drawn or gasoline vehicles. The introduction of 2400 volt equipment into trunk line work gives promise of an early and more general utilization of electricity by our big railways and the half-watt nitrogen filled incandescent lamp forces us to readjust our ideas of illumination possibilities. In electric heating we seem to have almost reached the point where we can compete, even in operating costs, with gas. This is especially true of electric cooking, where, considering also the other advantages, we may confidently look for a very rapid expansion during the next year. The commercial possibilities in almost every line of electrical application are now better recognized and to expansion in this direction there are no bounds in sight.

The Public Utilities Commission

The possibilities of a public utilities commission in adjusting unsatisfactory relationships between a municipality and a company have recently been satisfactorily demonstrated in Digby, N.S., where past conditions have been such that while the customers have felt the service expensive and unequal to the requirements, the company at the same time have been unable to realize sufficient returns on the capital expenditure to justify them in making any improvements. In adjusting the matters at issue the commission has pointed out that it is quite as unreasonable to expect a company to continue in business except at a reasonable profit as to expect consumers to be satisfied with a poor service, and in demanding a more extended service for the citizens of Digby they at the same time found the company justified in increasing their rates by a considerable amount.

The conditions in Digby seem to have become unusually unsatisfactory. Nearly all customers were on a flat rate, chiefly on account of the fact that they were exceedingly small users of electric current. It is said that economy on the part of the consumers was carried to such a degree that over 20 per cent. of the flat rate light users had only one lamp installed, which, of course, was allowed to burn all the time. The final adjustment goes to show that this commission is not prejudiced in favor of municipalities as against private companies, and that their first consideration is improvement of the service, which they accomplish by distributing the obligations as judiciously as possible from the evidence submitted. This is shown by the following decision in this particular case. (1) that all service should be metered; (2) that the rate should be 18c per kw.h. (instead of 12½c as formerly) with discounts up to 20 per cent. depending upon the amount of the monthly bill, with a minimum charge of \$1.15 per month; (3) that the rate for 40 watt tungsten lamps for street lighting should be \$13.75 per annum. The company on their part must extend the night service to 1 a.m., and during the tourist months, that is, from June 15 to September 15, must give an all-night service; from October till March morning service from 6 a.m. to sunrise must also be given.

Hydro in Port Arthur

The municipality of Port Arthur, who are supplied with electric energy from the Kaministiquia Power Company, through the Hydro-electric Power Commission of Ontario and so are considered by the Commission as subject to the same rules and regulations as govern other municipalities in Ontario served by them, are raising strenuous objections through certain members of their council to what they term interference on the part of the Ontario Commission. The municipality of Port Arthur is at present installing some new equipment in connection with which they are considering the issue of debentures. The Commission state that this is in opposition to the act which requires that extensions shall be made out of surplus earnings, where these exist, and the Port Arthur surplus at the present time is of ample proportion to take care of this expenditure. Another bone of contention is the appointment of a board of commissioners of three which is required by the act, whereas the light and power department in Port Arthur is controlled by a single commissioner.

It is claimed by certain members of the council that Port Arthur has special legislation which overrides anything in the Hydro Commission Act in these two matters, and the present attitude of the council appears to be to fight the issue. It is hoped, however, that a further consideration of the matter will result in the Commission's recommendations being found acceptable to Port Arthur since in an enterprise of the size and importance of the municipal power movement in Ontario it is important that the municipalities stand together in upholding a system which is found beneficial to the greatest number. It may be that in the case of Port Arthur the enforcement of the Hydro rules will work a certain amount of hardship, but it is open to question whether the attitude taken by one of the prominent aldermen that the surplus in the electric department should be used to offset deficits in other departments, is tenable. If each municipality were operating

entirely independently of every other municipality in Ontario, a system to link together the different public utilities in any particular town might well be feasible, but when the electrical department in Port Arthur is only one small link in a big municipal chain it does seem very necessary that that town should conform to the same requirements as other municipalities. This same tendency towards independent action has been noticeable in one or two other cases, but the wisdom of a united support seems to have been pretty generally recognized in the past and, we have no doubt, will be in the present instance. The Commission's hand will be weakened just in proportion as any municipality places obstructions in the way of the harmonious operation of their general plan of power distribution. The success of this municipal scheme may now be considered as more than assured but its highest success will only be achieved by united and unselfish co-operation on the part of the different municipalities being served.

An Unusual Situation

An unusual situation has developed in Morrisburg, Ont., where the municipality formerly owned a hydro-electric plant which is now being used, through the Hydro-electric Power Commission of Ontario, to supply light and power to a number of other villages and towns in the vicinity. The town of Morrisburg apparently resent the "export" of their power and are taking legal steps to recover possession of the plant.

The difficulty evidently arises from the ambiguous wording of an agreement between a Mr. Sharkey and the municipality, by which the former was given a long term lease of the plant with power to assign it to other parties on the written consent of the town council. This consent was given in 1912 and the lease was taken up by The Rapids Power Company. It is claimed by the municipality that the intent of the agreement was that the power should be used within the municipality, though this is not expressly stated, and that the sale of power to the Ontario Hydro Commission for use outside the municipality of Morrisburg is in opposition to the intention of the original agreement. Steps are therefore being taken to annul the contract between Mr. Sharkey and The Rapids Power Company.

The Ontario Hydro Commission are said to be making use of the Morrisburg plant only pending the completion of a generating system at Waddington,N.Y., from which point they will then obtain power. Delay on this work, however, is causing the citizens of Morrisburg some uneasiness as they foresee a possible local shortage of power in case no other source of supply is accessible in the near future. The stand taken by the late council is therefore, that while the present agreement must be cancelled, they will allow the commission a reasonable time to get power from Waddington or elsewhere, say two years, on condition that the control of the local plant revert to the municipality at that time.

Rates in Brantford

The light and power rates to be given in the city of Brantford, Ont., where Niagara Falls power will be available early in the year, have been definitely settled. Up to the present time this city has been served by a subsidiary of the Dominion Power & Transmission Company who generate and transmit from DeCew Falls near St. Catharines. The private company will continue to do business in Brantford, and, it is understood, will meet the figures of the municipal system. The new rates are as follows:—

Domestic Lighting

Service charge—4c per month per 100 sq. ft. of floor space plus a consumption charge of 3c per kw.h.

Commercial Lighting

Consumption charge—6c per kw.h. for first 30 hours' use of installed capacity; 3c per kw.h. for the next 70 hours' use of installed capacity; .15c per kw.h. for all additional consumption.

Commercial Power

Service charge—$1.00 per month per horse power of connected load or maximum demand plus a consumption charge of 1.9c per kw.h. for the first 50 hours' monthly use of connected load or maximum demand; 1.3c per kw.h. for next 50 hours' monthly use of connected load or maximum demand; and .15c per kw.h. for all additional consumption. Commercial power rates are subject to the following class discounts.

Class "A"—24 hours unrestricted use—No class discount.

Class "B"—24 hour restricted use—10 per cent. discount.

Class "C"—10 hour unrestricted use—10 per cent discount.

Class "D"—10 hour restricted use—33 1-3 per cent. discount.

All bills for power or light are subject to a discount of 10 per cent. for prompt payment. The restricted hours referred to are as follows:—

October 15th to October 31st—5.30 p.m. to 6.30 p.m.

November 1st to November 30th—5.00 p.m. to 6.30 p.m.

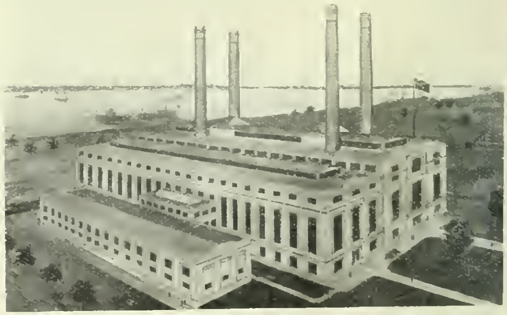
December 1st to January 15th—4.30 p.m. to 6.30 p.m.

January 16th to February 15th—5.00 p.m. to 6.30 p.m.

February 16th to March 1st—5.30 p.m. to 6.30 p.m.

Dominion P. & T. Company's New Steam Plant

The accompanying photo is an architect's drawing of the building which will house the Dominion Power & Transmission Company's immense auxiliary steam turbine plant at Hamilton, Ont. The photo shows the boiler room, turbine room, offices and transformer house. The plant is designed for six 10,000 kw. steam turbo-generating units—the turbines to operate at 200 pounds pressure 200 degrees superheat. The auxiliaries will be mostly steam driven except the exciters, which will be motor driven, although there will be one or two steam driven exciters. Surface condensers will be used as will also turbine driven air hot-well pump, circulating pump and boiler feed pump. The feed heater will be of the open type. The boiler plant will consist ultimately of 14 units each equipped with superheaters and under feed stokers. Definite plans for the interior arrangement are not yet quite completed.



Building to house the large steam auxiliary plant to be built in Hamilton by the Dominion Power and Transmission Co.

B. C. E. R. Co's. Electrical Activities

The big Coquitlam dam completed—New steel transmission tower lines—Best engineering results under most adverse conditions.

Starting operations at sea-level and working to and over an elevation of 2,000 feet and then back again to sea level within the short distance of seven miles is a condition not often encountered in the building of transmission lines. Such, however, was the case in connection with the construction of the new transmission line just completed for the Vancouver Power Company, a subsidiary of the British Columbia Electric Railway Company. This company has heretofore been operating at 34,000 volts transmitted over wooden pole lines, but with the additional installation of 42,000 h.p. at No. 2 power house, situated below Lake Buntzen on the North Arm of Burrard Inlet, it was decided to increase the line voltage to 60,000 volts and utilize steel instead of wooden towers for transmission purposes, wherever possible. The section of steel tower line just erected is seven miles in length, extending from No. 2 power house to Barnet crossing, the point at which the main transmission lines are strung across Burrard Inlet en route to Vancouver. The company's right-of-way between its main generating stations and Barnet is 100 feet in width and formerly carried two wooden pole lines of two circuits each, the pole lines each running twenty-five feet from the centre line. It was originally intended to construct the new tower line on the centre line, but this plan was later abandoned as impracticable on the ground that the angles would be too great for safety. The line as finally built crosses the old lines at several points, while at others it is directly over them, this form of construction necessitating a great deal of very close work, both in tower erection as well as in the stringing of cables. The foundations of all towers are of concrete. Tie rods were first grouted into the solid rock, forms and anchor bolts placed, and concrete poured, before any of the tower material had arrived from the factory. The towers stand 62 feet 6 inches over all from foundation level, with the lower wire strung at approximately 40 feet 6 inches from the ground. One 3/8 inch steel ground wire is carried at the apex of the towers. Ths distance between conductors is seven feet, these consisting of two 3-phase circuits No. 000, semi-hard drawn, seven strand, hemp core copper cables. Standard O.B. suspension insulators and hardware are used throughout. There are sixty-three standard towers and two special towers altogether, one of the latter being located at No. 2 power house, and weighing approximately five tons, while the other will be built for the Barnet crossing. The tower at Barnet will not be erected until next spring, the existing crossing facilities being utilized in the meantime.

Before proceeding to give a detailed account of the manner of erecting the towers, it might be as well to mention that although the actual distance from No. 2 power house, at sea level, to the level of Lake Buntzen is only half a mile, yet the land between these points rises to an elevation of 500 feet. The new transmission line follows the shore of Lake Buntzen for a distance of three miles, at some points being only a few feet above lake level, while at others it is constructed at least 500 feet above the level of the water, this being due to the indented nature of the lake shore, crags and bluffs of great height occurring at frequent intervals. After leaving the southerly end of the lake, the line passes over a mountain known as the Summit, which has an elevation of 2,000 feet above sea level. From here it drops down to the North Arm side of the mountain, and in the course of its windings towards the Barnet crossing, passes Deer Lake. This body of water stands at a height of approximately 200 feet above sea level and is about three-quarters of a mile in length. Fig. 1 shows the steel templet, in the form of a cross, used for the placing of anchor bolts in the concrete foundations for the steel towers. To the right in the picture will be noticed a pack horse loaded with South African water bottles in which water was carried for the mixing of concrete through the mountainous country met with on the route. Fig. 2 conveys some idea of the precipitous nature of the rocky bluffs upon which many of the steel towers were erected. The foundation forms as shown stand over 12 feet high, while the anchor bolts for the other two legs of the same tower are embedded in solid rock with no more of a concrete base than was necessary for levelling-off purposes.

The work on practically all of the foundations was rendered extremely difficult for the reason that it was impossible to blast on account of the direct proximity of the wooden pole transmission lines which were handling power for the city of Vancouver.

Fig. 1—Showing templet for placing anchor bolts,

The photograph in Fig. 3 shows two steel towers on the shores of Lake Buntzen as well as the two wooden pole lines. The presence of the wooden cross arm and insulator supporting one of the live 34,000 volt cables will be noticed on the tower in the foreground. The background provides a striking illustration of the wild country encountered directly on the route. Reference to this view gives an idea of the proximity of the steel towers to the existing 34,000 volt lines. These towers were erected with the 34,000 volt cables hot. On account of the uneven nature of the ground and the difference in the height of the piers, as well as the presence of the operating high tension lines, it was found necessary to construct every single steel tower in a vertical position, no space being available for assembling on the ground, and erecting afterwards.

Over the Summit the steel tower line runs between the two wooden lines. An aerial cableway or traveller was erected here upon which all material was conveyed to the summit. The use of this equipment was rendered necessary

Fig. 2—Tower footings on rocky bluffs.

Fig. 3—A section of the steel and two wooden lines.

Fig 4—Wooden poles, 60,000 volts.

on account of the fact that loaded pack horses were unable to negotiate the precipitious climb.

In addition to the steel tower line described above the Vancouver Power Company have built and placed in operation a single circuit wooden pole tie-line between its power houses Nos. 1 and 2, a distance of approximately 2,300 feet. This line, as will be gathered from Fig. 4, carries one 60,000 volt, three-phase circuit, as well as a ground wire on one end of the upper arm. This wire is used primarily as an equalizer, and secondarily as a ground. It should be mentioned here that the present 60,000 volt cables on this line will be removed in the near future and placed upon a single circuit steel tower line running alongside the present wooden pole line. The latter line will then be used for carrying two 2200 volt circuits as well as the telephone lines between the power houses.

The manner of constructing the base of the pole shown in Fig. 4 merits some explanation. The entire stretch of ground between the power houses is composed of solid rock with a very thin layer of earth above. It was therefore considered more economical in the placing of these poles to drill a 2¼ inch hole into the rock and also a 2-inch hole into the butt of the pole, then grout into the rock a 4-foot length of 2-inch round iron bar, 2 feet of which was in the pole and the other two feet embedded in the rock. Eight holes were then drilled for the same depth into the rock in a circle round the pole with a diameter of 18 inches. In these holes was placed reinforcement consisting of 5/8 inch round iron standing 2 feet 6 inches above the level of the rock. Forms were then built, these standing 3 feet 6 inches square and 5 feet in height, into which concrete was poured.

The greatest difficulty experienced in the construction of the steel tower line was that of transporting material. All of the steel required was carried along the route by the workmen employed on the contract, and the cement, gravel, sand and water for the concrete was packed in on horseback, as many as twenty-five horses being necessary. The different stages of transportation were as follows: Vancouver to the generating stations on the North Arm of Burrard Inlet by scows; generating stations to the level of Lake Buntzen over an inclined railway, thence along the lake on floats hauled by motor launches. From the lake shore onwards all material was carried by the workmen and on horse pack train. Both of the lakes mentioned in the course of this article were utilized not only for the transportation of material, but also for camp locations, in view of the fact that it was impossible to discover a level spot along the entire route of sufficient extent to even assemble a steel tower. Floats were built and boarded over and upon these the tents were erected, Fig. 5, the floats being towed down the lakes by motor

Fig. 5—The movable camp.

launches whenever it was found necessary to move camp. Transportation on the lakes was provided by three power launches, in addition to several row boats.

Mr. T. R. Cornick, who as contracting engineer, undertook the entire work in connection with the construction of this steel tower line, has had an interesting career. As field superintendent he handled the erection of the Mexican Light and Power Company's steel transmission lines, 170 miles of

direct transmission, under Mr. R. F. Hayward, now general manager of the Western Canada Power Company, and later erected all the ground wire masts and cable on the same line as an independent contractor. This work was accomplished within a proximity of 30 inches to 60,000 volt live cables. Coming to Vancouver at the inauguration of the develop-

Fig. 6—Rock toe installed, sluicing just beginning. —Lake Coquitlam dam.

ment of the Western Canada Power Company's project at Stave Lake, Mr. Cornick built the entire steel tower high tension system for this company, on independent contract work, between the generating point at Stave Lake and Vancouver, a distance of 32 miles. The contract he has just lately completed forms the first section in the work of rebuilding the Vancouver Power Company's high tension lines between Lake Buntzen and Vancouver, in conjunction with the additional power recently provided at the company's main generating station.

The Great Dam at Lake Coquitlam

The great dam at the outlet of Lake Coquitlam on which the British Columbia Electric Railway Company have been at work since 1908, and of which a detailed, illustrated pro-

Fig. 7 Up-stream slope during construction. -Lake Coquitlam dam.

gress description was given in the Electrical News of June, 1912, was completed recently and is now impounding an ample water storage supply for the company's two power houses on the north arm of Burrard Inlet where hydraulic and generating units are now turning out 67,500 h.p. of electrical energy, with plans for further development, up to a total output of 85,000 h.p.

The Lake Coquitlam dam has been constructed under the direction of the chief engineer of the B. C. E. R. Co., Mr. G. R. G. Conway. The structure is of the hydraulic fill type, with very heavy rock toes on both the up-stream and down-stream side. The maximum height of the dam is 99 feet and its length along the crest is 850 feet, the width at this point being 40 feet. The width at the base is 650 ft. The down-stream slope of the dam is 2 to 1 at the crest, 3 to 1 at the lower elevation and 4 to 1 from this point to the toe. On the up-stream side the slope is 5 to 1 and 1½ to 1. Both slopes are covered with rip-rap three feet thick. On account of these gradual slopes the total volume of the dam is very large, 530,000 cubic yards of material being employed in its construction. Of this amount 132,600 cubic yards is rock used in the toe walls and riprap. The remainder of the dam is of the hydraulic fill type, this material being almost entirely sluiced from the high hills on either side of the dam through flumes extending across the line of structure.

The work of sluicing was done by a large number of hydraulic monitors. The material is of a fine blue glacial clay, interspersed with boulders. This material when sluiced into the dam makes a perfect fill and the dam as it now stands is believed to be as solid and enduring as any dam on the continent.

During the construction of the dam the flow from the

Fig. 8–Completed dam and spillway.– Lake Coquitlam.

lake was diverted by way of a tunnel driven through the rock just east of the dam. This tunnel is 490 feet in length and has a sectional area of 400 square feet. Now that the dam is completed this tunnel is closed, but provision is made for its use in cases of emergency.

The spillway of the dam is about 15 feet below the crest and has a width of 250 feet. The capacity of the spillway is 12,000 cubic feet per second when the water is 7 feet deep over the sill. The plans for the spillway provide for a carrying capacity of three times the maximum flow from the lake according to records of recent years.

The new dam raises the lake level 60 feet and increases the storage capacity by 162,000 acre feet The total capacity of the reservoir is now 175,600 acre feet, or 7,560,000,000 cu. ft

The illustration, Fig. 8, is a general view of the dam, practically completed. The gradual slopes on both the up-stream and down-stream sides make the work appear of much smaller dimensions than is actually the case, as only a comparatively few feet of the total 650-foot width is visible.

Electrical Developments of the Year

A General Review of Progress in the Engineering and Commercial Sides of the Electrical Business during 1913

A review of activities in the manufacture and application of electrical apparatus during the past twelve months reveals no startling innovation but rather a consistent advance of a most general character including generation and all the various uses to which electricity is now put. In a general way, it may be said that progress in generation and transmission is along the line of larger units, higher voltages, and greater efficiency. In application, the uses to which electricity may be put are rapidly increasing and their popularity is becoming very pronounced, this condition being assisted both by the general tendency towards lower rates for electric energy and by the recognition of manufacturers and dealers that the field for small electrical appliances is a very wide and profitable one.

Alternating-Current Generators

The past year has brought forth several notable advances in central station practice one of the most important being improvements in turbo-generator design. Several horizontal turbine units with capacities of 15,000 to 20,000 kw. operating at speeds of 1,500 or 1,800 r.p.m. for 25 and 60-cycle work, have been installed and put into service during the year, and early performances indicate them to be exceedingly successful as regards reliable service and efficient operation. The most notable advance in this line of apparatus is the new design of the so-called "cross-compound" type of turbo-unit for ratings of 30,000 kw. and above. An order for three of these units has quite recently been placed with the manufacturers by the Interborough Rapid Transit Company of New York City.. The "cross-compound" idea is not an entirely new one, as in the very early days of Parsons turbine design, two separate and distinct turbines were mounted on the same shaft with one large generator. Due to improvements in the design of these units, and the difficulty of proper alignment, this design was superseded by one larger horizontal turbine coupled to a single generator. The "cross-compound" idea carries the original scheme out farther and removes any objectionable features such as difficulty of proper alignment, etc., inasmuch as it contemplates two separate turbines driving two entirely separate generators, one generator to be coupled to a high pressure, non-condensing turbine operating at the highest practicable, and consequently the most efficient, speed and the steam from this turbine exhausting directly into a low pressure cylinder operating at a lower and more efficient speed for low pressure steam, this low pressure turbine being direct connected to a second synchronous generator of similar capacity to the first, the leads of both generators being tied permanently together. These generators can be wound for any of the higher voltages considered practical today, such as 11,000 and 13,000 volts. This combination promises to be by far the most efficient unit yet to be designed, since guarantees made show a Rankine cycle efficiency of approximately 75 per cent. We understand that several of the Edison companies have also placed orders for machines of this rating.

Developments in generators to be driven by other types of prime movers, particularly water wheels, have been largely in the nature of increased capacities and refinements in manufacturing processes, enabling the manufacturer to build units even more reliable and efficient than in the past. Notably among these newer machines may be mentioned single vertical type units of capacities in excess of 12,000 kw., and operating at very low speeds, for coupling directly to single runner water wheels. Units ranging in capacity from 12,000 to 17,500 kv.a. have been installed, and are now in operation showing very satisfactory results.

Rotary Converters

While large 60-cycle commutating-pole rotary converters and 25-cycle commutating-pole rotary converters were previously developed to a great extent, they have this year fully demonstrated the claims of the manufacturer on performance by their successful operation. The results obtained prove them to be thoroughly satisfactory both from an operating and economical standpoint. The installation of ten 1500 kw. and two 1000 kw. 60-cycle rotary converters by the Cleveland Railway Company is worthy of mention, as it is the largest 60-cycle rotary converter installation in the world and is giving remarkably satisfactory results.

As in other classes of apparatus, the tendency is to the use of the larger units. Although no larger 25-cycle units have been developed during this year, the largest rotary converters that have been built to date have been completed and installed. Nine of these converters, which are of 2500 kw. capacity each have been purchased by the Aluminum Company of America. The field of the 60-cycle rotary converter has also been extended through the purchase by the Southern Power Company of three 500 kw. rotary converter units, consisting of two machines of 250 kw. capacity each mounted on a single bed plate and arranged for operation in series on 1500 volts direct current.

The Portable Sub-Station

Another development of great importance this year is the "Portable Sub-station." It is designed after careful consideration of all the requirements to be met, special attention being given to the safety of the operator and to simplicity in operation. The portable sub-station has not only been developed within the year, but has demonstrated in actual service that it fully meets requirements demanded for it. In the matter of high-voltage direct-current work, the tendency towards this opinion is shown in the purchase by the Southern Power Company of a portable sub-station for their railway work, the car to include a 500 kw. motor-generator to operate through suitable transformer, also mounted on the car, from either a 2,400 or 44,000-volt circuit.

Motor-Generators

The tendency in motor-generator sets, has been more and more towards the use of motors having condenser capacity, involving new designs. There has been however, no radical change in the design of motor-generator sets. The two 3,750 kw., 27-volt, 180 r.p.m. direct current generators, used with turbine and reduction gear, installed the latter part of last year for the Cleveland (Ohio) Electric Illuminating Company are the largest in capacity at 180 r.p.m. that have ever been built. They are not only demonstrating that they are satisfactory, but they are demonstrating the practicability of the turbine-reduction-gear direct-current generator unit.

Transformers

The trend in transformer construction is toward higher capacity units—higher primary voltages and higher reactance obtained in such manner as to provide increased strength against short circuit strains. This reactance protection is a

direct sacrifice in the regulation of such transformers but is coming to be generally recognized as a necessity to meet the new conditions imposed by the steadily increasing capacity of generating stations. A dozen years ago there were few, if any, stations with sufficient generating capacity to maintain normal impressed voltage with a short circuit on the line. To-day this condition is the rule rather than the exception.

In recognition of these conditions and in addition to the increased protection due to higher reactance designs the leaders in transformer manufacture have adopted improved methods of coil bracing. Straight spacing strips were superseded several years ago by the so-called "wavy spacers" and this has again given place to the "Button" type of spacer, which consists of rows of staggered buttons on the face of sheet pressboard.

This latest method of spacing and bracing shell type coils provides positive bracing for each and every turn at regular intervals of from two to four inches and at the same time gives entire freedom to the circulation of the oil.

During 1913 one Canadian factory has built and shipped twelve 1000 kv.a. oil-cooled transformers, these constituting the largest self-cooled transformers yet manufactured in Canada, and work is well in hand on several 110,000 volt transformers and on two 6,750 kva., three-phase transformers of interest on account respectively of the high voltage and high unit capacity. Of almost as high capacity and actually of larger physical dimensions are three 25-cycle, single-phase, 6000 kv.a., 86,500 volt transformers together with three 5,500 kv.a., 76,000 volt step down transformers for the same transmission company.

In the field of the small transformers there has been a notable increase in the demand for higher voltage distributing transformers. The leading manufacturers are providing in these small high voltage transformers the same high factor of safety in insulation values, which have led to the well known long life characteristics of safety and durability in their standard 2,200 volt transformers.

Insulating testing transformers and their control have been further developed. Transformers giving 500,000 volts from high tension to ground under normal conditions have been put into successful operation.

Extensive increases have been made in high capacity, high voltage transformers for hydro-electric systems, as exemplified by the fourteen (14) 150,000-volt transformers recently installed for the Pacific Light & Power Company. It is interesting to note that for these higher voltage units, there is employed an extension of the already well developed condenser terminal instead of having recourse to some untried scheme. The developments of the existing line seeming to meet the conditions imposed by the higher voltages in an entirely satisfactory manner.

Particularly noticeable has been the continued growth in the use of outdoor transformers. The power transmission companies and railway companies are beginning to realize the importance of the electrification of the small community and the farm. During the year a number of complete outdoor sub-stations consisting of transformers, switching and protective equipment of steel towers have been installed.

A recent order of more than usual interest is one from the Southern Power Company for a portable sub-station for power and lighting. Different from most portable sub-stations, this one contains only transformers with switching and protective equipment. There will be three transformers, each of 1000 kv.a. capacity of the self-cooling type. The high tension voltage will be 100,000 and the transformer will be designed so that it can be used on voltages of 100,000, 11,000 or 13,200. The low tension side will be arranged for 13,200 and 2,300 volts. This portable sub-station will be sent from place to place and used while repairs or extensions are being made at the various sub-stations.

Current Transformers

A new line of current transformer has been developed for use on voltages up to 2,500 volts. These transformers represent a very material improvement over previous transformers in the matter of accuracy, both the phase angle and the ratio error being considerably decreased. The transformers are of very simple construction, consisting of a core built up of E punchings with form wound secondary and primary coils assembled around the center leg. Primary coils are insulated from the secondary coils and from the core by layers of varnished cambric. The test voltage used is four times normal, showing a very liberal factor of safety for the insulation.

Railway Loads Carried by Central Stations

The number of railway companies operating partly or entirely on power purchased from central stations is greatly increasing each year. The 60-cycle rotary converter through its economical and reliable operation makes possible such arrangements with mutual advantage to both the railway company and the power company.

Switchboards

Switchboard design has so developed that now there are several important types of switchboards especially applicable to typical service conditions met in railway work such as,—desk types boards for large generating stations; typical generating systems for city service; typical 600-volt d.c. generating and distributing boards; 1,200, 1,500 and 2,400-volt d.c. for railway service.

In the field of switchboards proper—the changes and innovations during the past year have been relatively small in number. One of the most noticeable features has been the increasing demand for what might be termed "the vertical type of benchboard." The usual type of desk or benchboard while economical in the matter of space—is at the same time relatively expensive to build and install, and access to the small wiring at the under side of the bench is not easy. The photograph herewith, showing switchboard for the Winnipeg Electric Railway Company's Transcona sub-station, gives a good idea of the new type of board. The mimic buses and connections together with the control switches are mounted on the face of the vertical panels, at a height best suited for operating purposes. Such a board, with its instruments, meters and relays, usually takes up even less space than the old style benchboard, and is at the same time a simpler and hence better switchboard. In the position shown the control switches are as easily operated as when on a bench. This type of board will be used by the Toronto Power Company for their Niagara station—replacing the existing benchboard—and by the B. C. E. Railway Company for the large step-down transformer stations at Sapperton and Hastings.

Of the higher voltages may be mentioned the board for the Piedmont Traction Company, the largest 1500-volt direct-current railway service in existence. All 1500-volt breakers switches and conductors are placed at the top of the board out of ordinary reach. These switches and breakers are of the remote control type, being operated from a handle mounted on the central panel. All handles are insulated by specially treated wooden rods. Accidental contact with high voltage by attendant when operating board is impossible. These boards control two 750 volt, direct-current generators connected in series in order to deliver 1500 volts which is the trolley voltage of the system. The sub-stations along the line are placed from 15 to 25 miles apart to meet the varying traffic conditions and points of delivery of power by high tension lines.

Another step forward in the development of high voltage

d.c. switchboards has been made through the successful design of 2,400 volt equipment. The 2,400 volt switchboards follow in general along the lines of the well-known 1,200-volt boards. The circuit breakers and disconnecting switches are remote control-mounted, however, separate from and in the rear of the panels, rather than at the top of the panels themselves as in the case of 1,200 volt boards. This change is made mainly to afford additional safety for the operator. The circuit breakers are equipped with carefully designed magnetic blowout arc chutes, and are provided with ample barriers to prevent any possible trouble from the severe arcing to be expected at this voltage. Ammeters are supplied with insulating covers with glass fronts, and all live parts are thoroughly protected so as to make accidental contact very difficult.

Arc Lighting

The illumination of streets at night was formerly considered the only function of lighting units, but in this twentieth century spirit of progressiveness and economic management, the tendency is to make the lighting units so attractive that they enhance the appearance of the landscape by day as well as by night. The status of the magnetite luminous arc lamp is now well established and the phenomenal success of the pendant type, combined with the present demand for a more ornate unit, has resulted in the later development of the ornamental luminous arc lamp. This lamp has the same characteristics and embodies the same principles as the pendant type; in fact, it is the same lamp with the arc placed above the mechanism, only such changes being made as were mechanically necessary. This lamp now permits the use of a pole which lends itself to highly artistic treatment. The single lamp on top of the pole enhances the appearance of the street or boulevard on which it is installed, while at night the effect of high candle power, with the light softened and diffused by a specially designed globe, is very good. The light is pearl white, of high efficiency, and low intrinsic brilliancy. There is an entire absence of glare and shadows.

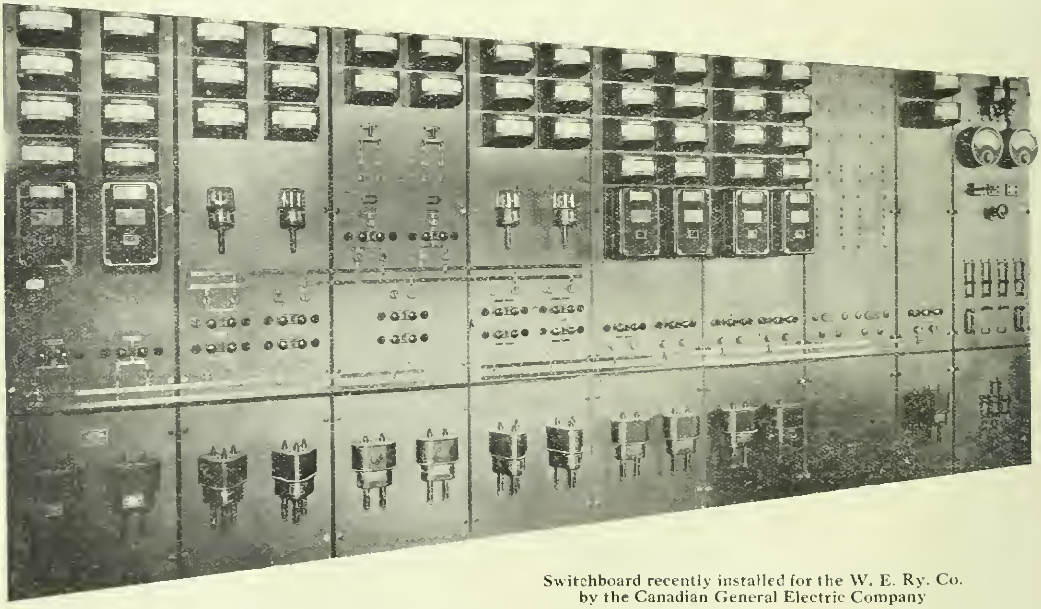
There has also been developed and placed on the market a new line of flame carbon arc lamps adaptable to all commercial circuits. A flaming arc lamp has also been developed which is claimed to operate satisfactorily on 25 cycles and burn 120 hours per trim. The specific efficiency of this latter lamp is 3½ to 4 c.p. per watt according to circuit conditions.

Electric Traction

In the electric traction field the greatest advance has been made along the lines of high voltage direct current operation for the heaviest class of trunk line service. One of the big manufacturing companies has adopted 2,400 volts direct-current for service of this nature, and a few months ago secured a contract from the Canadian Northern Railway for locomotives, motor cars, and sub-station apparatus of 2,400 volts to be used in connection with the tunnel under Mount Royal and the terminals in the City of Montreal. A description of these locomotives appeared in the Electrical News of December 1. To show that there is nothing of an experimental nature about the electrical equipment for this service the following letter from Mr. Gallwey, general manager of the Butte, Anaconda & Pacific Railway, is of the greatest interest. This company operates the equivalent of 90 miles of single track with seventeen 80-ton locomotives with overhead catenary construction at 2,400 volts d.c.

"In reply to your inquiry I would say that on October 1st, 1913, the Butte, Anaconda & Pacific Railway established regular electric passenger service between Butte and Anaconda. For approximately four months previous to this the freight service between East Anaconda yards and the smelter had been handled electrically. During this period electric locomotives have made approximately 55,000 miles and have delivered to the smelter about 1,500,000 tons of ore. Since starting the electric service there has been no failure of any of the electric apparatus and no delay in any way attributable to electric operation."

A direct result of the successful operation of 1,200, 1,500 and 2,400 volts d.c. equipment for railway work has been the changing over of a number of railway systems from single-phase to high voltage d.c. operation. In addition to the two above mentioned 2,400 volt systems, the Michigan United



Switchboard recently installed for the W. E. Ry. Co. by the Canadian General Electric Company

Traction Company, of Jackson, Mich., are now preparing to place twenty 2,400 volt electric locomotives on their lines, and the C. P. R. are so equipping part of their Pacific system.

Electric Vehicles

The principal increase in the demand for electric vehicle equipment has been in connection with trucks and delivery wagons. In New York city 40 per cent. of the power vehicles devoted to business are of the electric type and electric trucks are now employed in 76 different kinds of business. The electric truck has also been used to solve the transportation problem, as for example in New York, where 120 battery cars, each with a seating capacity of 28 persons, are now operating.

The design of the electric truck and the efficiency of the storage battery has now reached a very reasonable degree of perfection and the prejudice against the earlier and less satisfactory equipment has been almost overcome. Merchants are realizing that a greater amount of ground can be covered at smaller overhead expense and central stations are recognizing also that this form of load is a highly satisfactory one.

Considerable advance has been made in the system of charging, although this remains one of the obstacles in the way of rapid increase in the use of electrics, especially of the passenger type. There is now becoming established, however, in the larger places, a more satisfactory system of charging stations and good results are expected from a new type of motor-generator of small capacity, recently placed on the market. A rapid expansion in the electric vehicle business may confidently be looked for during the next year.

Small Motors

There is a continual increase in the use of small motor-driven machines for the office, home and store. This is due to the distinct advantage of a motor-driven machine over a hand-driven machine. Central stations have been very active in promoting the sales of these machines as have dealers and jobbers. The demand over the country has been fairly uniform. The method of driving washing machines, for example, by motors has been greatly simplified and the mechanism used on later types of machines has been such that the machine and driving mechanism is fully protected from interference by the operator and in turn fully protects the operator from injury from moving parts.

There has been a great increase in the demands for motor-driven office machinery such as adding machines, mailing machines, addressing machines, combined computing and typewriting machines. This has been due not only to the perfection of the motor-driven machines, but also to the fact that there is an increasing tendency to analyze the cost of operating offices. The remarkable increase in the quantity of mail matter transmitted from point to point throughout the country, in the use of circular letters and in the distribution of all kinds of printed matter, has increased the demand for this type of machinery and has made motor-driven office machinery more popular.

The demand for motor-driven air pumps has increased to a remarkable degree, these being principally used in connection with garages for producing compressed air for blowing up automobile tires.

Water pumps have been used in the home, apartment and hotel. There is a particular demand for these in suburban districts and this is often necessitated by the condition that in several districts throughout the country hard water is plentiful but there is a small supply of soft water. Private supplies of soft water must be obtained and rain water is usually collected and distributed throughout the home and out-buildings by means of an electric pump which pumps the water into a central tank, or else by some use of an air pump and pressure system.

A great number of popular amusements such as moving picture shows, entertainments, lectures, etc., is increasing the frequency in which masses of people are gathered together indoors. This fact, connected with the realization of the benefits of good ventilation, and the injurious effect of poor ventilation has brought about an almost universal use of motor-driven ventilating fans and blowers.

The vacuum cleaners of various types continue to grow in popularity. The stationary type has now become a necessity in connection with public buildings and is considered just as carefully as a heating or ventilating system. The very small high-speed fan type vacuum cleaners have become more popular in the smaller homes, although the larger homes are often installing stationary types. The heavy portable type is used only to a limited extent in connection with the home but is largely used in public buildings where an attendant is available to move it from floor to floor during the process of cleaning.

Electric Welding

The use of electric welding has been greatly increased through the supply of the proper equipment by the manufacturers. The welding of metals by the electric arc may be briefly defined as the fusing together of two metals, without pressure, allowing them to melt, mix, unite and then cool. For heavy cutting and for the repair of castings which show defects of blow-holes and imperfect formation, and for general work, the metal to be welded is made one terminal of the direct-current circuit, and a carbon electrode the other. Upon placing the carbon electrode in contact with the metal and then simply withdrawing the same, an arc is established between the two. By this means, which produces the hottest flame known, having a temperature between 3,500 and 4,000 deg. C., the metal may be either directly welded, melted away, moulded into a different shape or fused to another piece of metal as desired. With this process the current ranges from 180 to 1000 amps., depending upon the class of work being done, 250 to 350 amps. being the average value for ordinary work. For lighter and smaller repair work the metal to be welded forms one terminal of a direct current machine while the other terminal is formed by a metal pencil instead of the carbon electrode. This pencil is usually 3-16 to 3/8 inches in diameter coated with a suitable flux, and the operator holds it by means of a pair of plyers or tongs connected to the terminal. The arc is drawn as described above, and with a 1/4-inch carbon, is approximately 3-16-inch long taking from 150 to 180 amperes. This latter process is used extensively in railway shops for flue welding, boiler and fire box repair, also in machine shops for repairing steel castings, etc.

A 75-volt commutating pole d.c. generator driven by a motor is generally used. Several sizes of motor-generator sets, especially adapted for arc welding work are now on the market. The apparatus is especially useful in repairing fire boxes of steam locomotives, repairing engine frames and for general repair work, as found in machine shops.

Magnet Switches and Control

The past year has seen the introduction and successful operation of a line of magnet control switches for industrial service that bids fair to very greatly enhance the application of electric motors to severest industrial requirements. Their design was preceded by long and careful study of the needs of this service and by extensive experimental work. One particular point of this new type of control is that the control systems have been very much simplified, due to the use of a specially designed series type of contactor. It has recently been demonstrated that magnetic controllers are especially suitable for hoist motion of cranes, especially where controllers of large capacity are used. One special feature, now

included in magnetic controllers in particular is dynamic braking which is very useful in the lowering motion. This feature in the controller permits of a much simpler mechanical construction of the crane, as a mechanical brake is not required. Elimination of this particular feature (mechanical brake) is quite an advantage to the user, as it is a rather complicated piece of apparatus and requires considerable attention and as a rule, is the source of considerable trouble. The steel mills of to-day have practically adopted the magnetic control for the majority of the motor applications, where the service is of intermittent character. There has recently been developed a very simple system of control for blast furnace skip hoists. Several of these controllers are in operation.

Large Motors for Steel Mills

One of the large manufacturing companies secured an order from the Bethlehem Steel Company about the middle of last year, which is rather unique in character. At the present time, all of the reversing blooming mills in the United States are driven by steam engines. The Bethlehem Steel Company ordered a reversing motor equipment to drive their 35-in. blooming mill. Although there are two reversing blooming mill equipments operating in Canada, the equipment for the Bethlehem Steel Company will be the only one in the United States and, it is said, will be much larger than the Canadian equipments. It is believed that the results obtained at the Bethlehem Works will do much to stimulate the interest of the steel companies in equipments of this kind. It is a radical departure from steam engine practice and the steel companies have been slow to take up with the motor idea for reversing work, although the above manufacturing company alone have approximately 100,000 h.p. in motor equipments driving non-reversing mills.

Steel Frame Induction Motors

For a long time the squirrel-cage induction motor has been considered nearly the acme of perfection. The last year, however, has seen a further refinement of this motor in the production of a new steel frame squirrel-cage induction motor, designed for constant speed, continuous service, 20 to 200 horse-power, 110 to 2,200 volts. This new development represents what is claimed to be the most satisfactory induction motor ever produced commercially. Special features of its construction are: steel is largely used throughout, not only providing great strength, but reduces weight to a minimum; rotors practically indestructible; bearings have liberal areas; non-leaking and dust proof; construction simple and number of parts small and interchangeable; efficiency, power-factor, and overload capacity are unusually high.

Slip-ring A.C. Motors

A new motor of the above type embodying many advanced features of construction has also been brought out within the year. It is especially designed for operating small cranes and hoists and for other severe intermittent varying-speed reversing service. It is built in capacities of 2 and 3 h.p. 3-phase, 220 and 440-volt, 60-cycles, 6 poles. The frame is built of rolled steel. The bearings have liberal areas and are non-leaking and protected fram dust. Special attention has been given to ease of dismantling, so that in case of accident repairs can be readily made.

The torque that can be developed is the maximum obtainable for the rating. The speeds are comparatively low. The stator is of the frameless type. The core laminations are riveted together under high pressure between pressed steel rings called end shields. A one-piece pressed-steel foot is rigidly attached to the end shields. Each bracket has on its face a machined flange which fits inside the frame and insures rigid support and perfect centering of the bearings. The rotor is comparatively long and of small diameter, thus reducing the fly-wheel effect. This feature, together with the perfect balance and secure attachment of the windings, make these rotors especially adapted for frequent starting, stopping and reversing.

Electricity in Mines

The past year has seen a remarkable increase in the amount of power contracted for by central stations in the coal mining field, combined with which has made an increased demand for synchronous motor-generator sets as against rotary converters, by reason of the over compounding feature which is necessary in order to take care of the large line drop, experienced in coal mine distribution. The purchase of power by coal operators is looked upon more favorably than ever before.

A great advance has been made in the application of heavy electric hoisting from both coal and metal mines, the most notable being the recent order placed by the North Butte Mining Company of Butte, Mont., which is the largest electric hoist installation in the United States, up to the present time.

The introduction of the self-starting motor for direct current up to 20 h.p. has met with great favor, as it eliminates the complication of automatic starters, or the necessity of starting manually a pump or fan inside the mine every time the circuit breaker opens due to overload or other cauess.

The general demand for the barsteel locomotive frame construction with the use of commutating pole motors has shown that this latest development in locomotive construction has been in the right direction, as has also been demonstrated in the use of bronze motor bearings with oil waste packed housings in line with the most modern street railway practice.

The increasing sales of motor-driven compressors, particularly in metal mines, has demonstrated the superiority of this type of machine where power is available either from central public service stations or from privately operated central energy plants, where standby losses are reduced to a minimum. One of the principal advantages is the ease of locating the compressor stations nearer the application of the air to the work, thus reducing the transmission losses in the air system.

Pole Line Equipments

We note, during the past year, an increasing tendency toward the use of the highest grade of material obtainable. More and more companies and municipalities are calling for braces, bolts, rods, clamps, etc., made in accordance with standard specifications. The most remarkable feature of the year's developments, however, is the rapidity with which steel is replacing wood. Although most apparent in high voltage lines, this change is affecting all overhead constructions and is a move in the right direction since it gives the advantages of safety and freedom from expensive renewal at a very slight increase in first cost, and, when maintenance charges are considered, represents a considerable saving.

The majority of new lines of less than 60,000 volts are limited to a single circuit, the practice being to follow separate route when an additional circuit is necessary. This arrangement greatly favors the use of a steel fixture, combining arms, braces, and in the lower voltages, pins and ground wire supports. The "Bo-Arrow" arm, made of angle steel in triangular wire spacings of 36 in. to 72 in., was introduced last spring and met with favor over 10,000 arms being placed in service during the year. For a 24 in. triangular wire spacing the "Hi-Ten" fixtures of steel pipe received an equally gratifying reception. In brief, these fixtures give permanence and safety to construction work at a cost which is actually less than that of a good grade of wood construction, due in part to the lower cost of installation on poles. There is a noticeable tendency in recent practice to increase the wire spacing for a given voltage, probably on account of a desire to raise the voltage at some future time.

About ninety per cent. of the lines recently built are equipped with overhead ground wires, and many companies are installing such protection on all their older lines, as its efficacy seems to have been proven, assuming the wire to be properly clamped to a well designed bayonet. In some quarters there is an objection to the use of grounded metal arms, which is met by tying the ground wire on a smaller insulator screwed on a steel spring thread on the end of the bayonet. When desired, the ground wire is used as a neutral of 4-wire, 3-phase system.

The clamp pin is replacing the wooden and malleable types for all kinds of high and low tension service with wooden arms, because its use develops the full strength of the arm instead of half the strength, as in the old type of pin. There are no holes to allow water to reach the heart of the arm and cause decay and splitting, and the saving in maintenance charges is considerable. In one large system clamp pins are used exclusively, and on this account the fir cross arms used are guaranteed by the supplier to last 20 years.

The present day policy of supplying power to all sizes of consumers has produced some problems in the proper supporting of transformers on poles, and a good solution seems to be to use angle and channel steel platforms for one or more poles, depending on the size and number of units required.

Oil Switches and Breakers

Numerous improvements have been made in medium capacity oil switches for voltages up to 15,000 volts. The new lines are provided with greater spacings between poles, larger air and oil space, and improved insulation between live parts and the frame (ground). The most distinct improvement, however, lies in the use of "clamped in" insulators. This is a very strong and simple construction which obviates the necessity for the use of cement or babbitt for fastening the bushings to the frame, and also allows the bushings to be readily removed when necessary. The clamping surfaces are perfectly trued and drilled, and thus the replacing of parts is accomplished quickly and perfect alignment is insured. The bushings themselves are one piece porcelains—and extend below the oil level—thus increasing the insulation qualities of the switch.

Oil type breakers have been built for operation on voltages as high as 165,000. The details of these breakers closely resemble those of standard lower voltage breakers. Reactance type breakers have been developed to cover voltages as high as 110,000. They have been developed along the lines of two forms—one arranged for floor mounting, voltages ranging from 25,000 to 165,000; the other arranged for cell mounting, for voltages up to 22,000. Both forms are nominally rated at 200,000 kv.a. ultimate breaking capacity.

The carbon-break type has been extended to cover capacities from 200 to 800 amperes in addition to the capacities of 1,000 to 20,000 amperes as developed in the year 1912.

Condensers

Condenser practice, both jet and surface has received tremenduous stimulus by the hydraulic air pump, particularly the Westinghouse-Leblanc air pump, and is moving forward with very rapid strides. In surface condensers of recent construction the heat transfer formerly considered the maximum obtainable has been easily doubled.

Prime Movers

Steam engines of the Corliss type for electric light plants, office buildings, hotels and smaller generating stations are now being installed to operate at speeds from 150 to 250 r.p.m., according to the work, permitting the use of a moderately small sized generator. This makes a complete engine and generating set very compact in floor space and embodying high economy and smooth running. The tendency in water turbines of the smaller units is still in favor of the horizontal shaft type. Normal speed turbines continue to demonstrate their superior working qualities. In Canada the conservation of our water powers is a very live topic and promises to increase in interest as the years go by and the efficiency of the hydro-electric equipment installed will therefore be a matter of extreme importance. We believe our engineers will do well to make a specially careful study of the efficiency of the various types and speeds.

Tungsten Lighting

Tungsten lighting in the home has now become standard with the latest developments of wire drawn filaments. For street lighting in smaller towns and in side streets of the large towns and cities they are being invariably used, some very efficient series systems having been developed. Series tungsten street lighting, has received an additional impetus through the development of the nitrogen filled type of tungsten lamp. The old method of supporting lamps on expensive center span suspensions is giving way to the use of the hinged tungsten arm, which permits the lamp being supported beyond the line of foliage of the trees, and still be accessible for cleaning and renewals, at a cost of approximately one-third of the old way.

High Voltage Transmission

Steel frame towers with suspension insulators have become the established practice for voltages of 60,000 and over. During the year the flexible or A frame type of tower appears to have found its field in high voltage work both for single and double circuits. For lower transmission voltages there appears to have been considerable inquiry for steel poles of moderate cost which can be spaced 200 to 300 feet apart and furnish a permanent type of construction at about the same cost as the old wooden pole line. This demand is now being met satisfactorily by a number of manufacturers.

Meters

Developments have chiefly been along the line of refinement in construction, as one manufacturer states "frames of all forms have been stiffened by flanging the edges and along one side of the disc opening. The magnet supports have been altered to eliminate any possible springing. The new support is an aluminium bronze casting stiffened by ribs, and the shape has been changed to reduce the over-hang. The fulcrum support on which the magnet support is pivoted is fastened to the frame by four screws instead of by two as formerly. The micrometer adjustment of the magnets is not changed except that larger screws are used. These changes greatly reduce the possibility of damage or derangement from rough handling, etc."

During the year there has been some inquiry for the two rate system of meter and also for the prepayment type. One company has introduced on the Canadian market a current limiter, which by a simple device prevents the customer from taking more than a stated amount of current off the line.

A new totalising meter has also made its appearance and promises to be in demand with the larger operating companies.

Electrical Fittings

Unusual activity has been evidenced along the line of small fittings following the development in electrical contracting and the activity of municipalities and companies in demanding more rigid inspection. The class of work now being installed is greatly superior to what it was two or three years ago and there has been an increased demand for conduit, condulets, outlet boxes, etc. The demand for this equipment is shown in the fact that one Canadian company have, during the past year, developed a complete line of wiring devices, key and keyless sockets, knife switches, etc.

Electrical Control of the Panama Locks

A Detailed Description of the Control of the Canal Locks, Terminals and Auxiliary Equipment which are all Electrically Operated

The electrical specification, design and manufacture of the Panama Canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouses a lively interest but also presents an opportunity for much valuable instruction. The interest results mainly from the immensity of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the isthmus with speed and safety. The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling, and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission, assisted by a staff of able electrical engineers, including Mr. C. B. Larzelere, who was closely identified with the lock control problem, and Mr. W. R. Mc Cann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

Generation and Distribution

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lok control, is composed of:

One 7500 kv.a. 2200 volt hydro-electric power plant at the Gatun dam;

One 4500 kv.a. 2200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

A double 44,000 volt transmission line across the isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000 2200 volt sub-stations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2200 240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2200/220/110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

The system of connection throughout employs a double bus, double switch scheme, with provision for disconnecting any oil switch for cleaning or repairs without interrupting the circuit. In the power house and the four 44,000/2200 volt sub-stations, the oil switches are solenoid operated and are installed in concrete cells, above which are concrete fireproof compartments containing the two sets of buses. In the thirty-six transformer stations in the lock walls the oil switches are hand operated. All 2200 volt oil switches have disconnecting switches, so arranged that live parts are completely covered.

For the hand operated switches, a pipe framework supports vertical metal guides which carry the oil switch operating mechanism and slate base forming a section of the switchboard panel. On the guides a lever and toggle mechanism is mounted, by which the oil switch and slate base may be raised and lowered. Above the oil switch and mounted on the pipe framework a stationary cast iron base carries the disconnecting switch studs and insulators. The high tension leads run to the tops of the disconnecting switch studs, and the bottom of each stud is equipped with contact fingers. On the top of each oil switch stud is mounted a contact blade. When the oil switch is raised, these blades engage the contacts on the bottom of the disconnecting switch studs, which thus in the closed position form extensions of the oil switch studs. The disconnecting switch contacts are surrounded by insulating shields which prevent accidental contact. When the oil switch is lowered, it is completely isolated from the circuit. When the oil switch is raised, it always goes to a fixed height where it is latched. An interlock prevents the oil switch from being raised or lowered unless its contacts are open, precluding the circuit being closed or opened by the disconnecting switch.

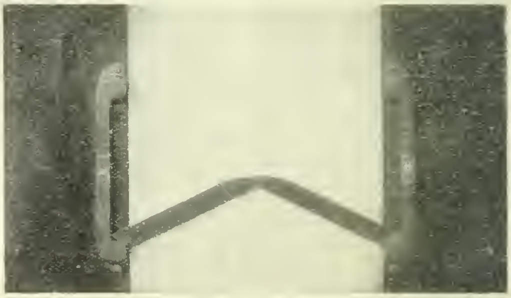


Fig. 1—Miter gate index, lock control board

In some instances another interlock makes two single-throw switches a double-throw switch and prevents both switches being closed at the same time.

For solenoid operated switches, the same form of disconnecting switch is used; but the solenoid is stationary and the connecting mechanism to the oil switch has a vertical slotted link which allows the oil switch to be raised and lowered without being disconnected from the solenoid mechanism. A mechanical interlock prevents the raising or lowering of an oil switch while in the closed position.

The instrument and control board for the Gatun generating station is of natural black slate, as are the switchboards for the power system. It is totally enclosed by means of grill work with doors at each end. The switchboards for the transmission line sub-stations are of the vertical type, with control apparatus and mimic connections symmetrically arranged on the middle section of the panels. The rear of the board is enclosed by means of grill work with doors at each end.

Power supply and control panels for lock machinery motors

Current for the lock machinery and towing locomotives is transformed from the 2200 volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations, for all locks, each containing duplicate

200 kv.a., 3-phase, 2200/240 volt transformers for power, and one single-phase, 25 kv.a., 2200/220/110 volt transformer for lighting. The stations, normally fed from the 2200 volt buses in the 44,000/2200 volt sub-stations, can also be operated from the power plants—the stations at Gatun locks from the Gatun hydro-electric station, and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

As giving an idea of the number and size of motors used in operating the lock machinery, the following table is interesting:

Machines and Operation	Motors each Machine and H.P.	Number of Motors Gatur	Ped. M.	Mira.	Tot.	Total Horse Power
Miter gate, moving, each leaf	1-25	40	24	28	92	2300
Miter gate, miter forcing....	1- 7	20	12	14	46	322
Fender chain, main pump	1-70	16	16	16	48	3360
Fender chain, operating valve	1-½	16	16	16	48	24
Rising stem gate valve......	1-40	56	24	36	116	4640
Cylindrical valve	1- 7	60	20	40	120	840
Guard valve	1-25	6	6	6	18	450
Auxiliary culvert valve	1- 7	4	4	4	12	84
Totals		218	122	160	500	12020

There are many motors not included above, as, for instance, those for the spillway gates, for the hand rails on the mitering gates and for the sump pumps. The spillway gates are remote controlled from a special control board, and the control of the hand rail motors is given in connection with the discussion of mitering gates.

The motors are started and controlled by contactor panels located near them, the contactors of which handle the main motor currents. These contactors are controlled from the central control house. The smaller motors, including those for cylindrical valves, auxiliary culvert valves and miter forcing, are started by being thrown directly on the line. Two double-pole contactors are used, one for forward and one for reverse. In the case of larger motors for miter gate moving, rising stem valves and guard valves, a starting point with resistance in two legs of the three-phase circuit is provided.

In all cases the contactors are operated from the control boards—to be described later—by three wires, one for forward, one for reverse and a common return. In the case of panels having a starting point, the period during which the motor remains on the resistance is automatically controlled by a dashpot, so that the starting operation at the control house is the same, simply energizing a forward or reverse wire as the case may be. The control connections are arranged in such manner that each individual machine may be controlled locally. This arrangement provides for emergency operation should the control circuits from the central control house be out of order.

Location and operation of lock machinery

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for manoeuvring ships and protecting the apparatus from the weather without erecting numerous houses.

The Gates

The mitering gates consist of two massive leaves, shown in miniature in Fig. 1, pivoted on the lock walls which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends there are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position by a device called a miter forcing machine.

On the top of all mitering gates a foot walk with hand rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand rails

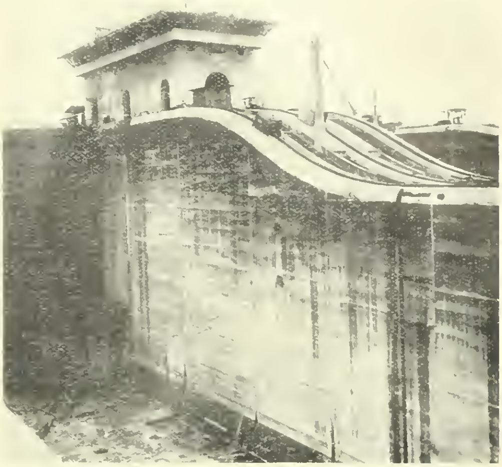


Fig. 2—View of channel, showing control house, centre wall and towing track incline

are therefore made to be raised and lowered. This is done by a motor under the foot walk, controlled from the lock wall. Near the approach to each foot walk a controller is located in the lock wall flush with the surface, this controller being operated by a foot push. If the gates are closed and the hand rails are down, and it is desired to cross on the gates, the foot push is pressed and the hand rails are raised by their motors. This is true not only of the hand rails on the nearer gate leaf, but of the hand rails on the farther leaf as well. After passing across, one can, if one desires, press the foot push on the other side and both hand rails will be lowered. Or, if one leaves the hand rails up and the gates are opened by the operator in the control house, they will be automatically lowered so as to be out of the way when the gate is in the recess. When the gates are again closed, the hand rails will automatically rise again if the foot controller has not been operated in the mean time. The hand rails cannot be raised when the gates are opened and no harm results if the foot switch is operated while the gates are in the closed position.

Chain fenders

The chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors; one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the

chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the has performed its function.

Filling and emptying

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers, and up through openings in the lock floors (See Fig. 2).

The rising stem valves are installed in pairs, and each pair is in duplicate; also each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve and make it more easily operated, each valve being 8 by 18 feet. One pair of duplicates is left open as a guard, or reserve pair; the other pair is used for operating, so that in case of an obstruction in the culvert or accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. They perform service exactly similar to the rising stem valves, except that three valves in parallel in this case must conform to the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks, there are two valves in the side wall for regulating the height of water between the upper gate and upper guard gate, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lake. These valves are called the auxiliary culvert valves.

Reasons for control system adopted

As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to co-ordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, the operating expense, and liability to accident. To accomplish this system of control, a control board for each lock was constructed which permitted having all control switches located thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.

Centralized control and indicating system

The control boards, Fig. 3, are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable because of the many contacts and small pieces in their construction; and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point.

A complete synchronous indicator consists of a transmitter, Fig. 4, located at and operated by the machine in the lock wall, and a receiver, see Fig. 6, operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have three-phase windings with leads from three corresponding equidistant points brought out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110 volt 25 cycle single-phase source.

The movement of the lock machinery and with it the connected transmitter rotor produces a field in the transmitter stator polarized in the direction of the rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the three-phase connection above mentioned to the receiver stator coils and duplicates in them, but in the reverse direction, the same conditiins of polarity and voltage as present in the transmitter. The rotor of the receiver, being energized by the external source in the same direction as that

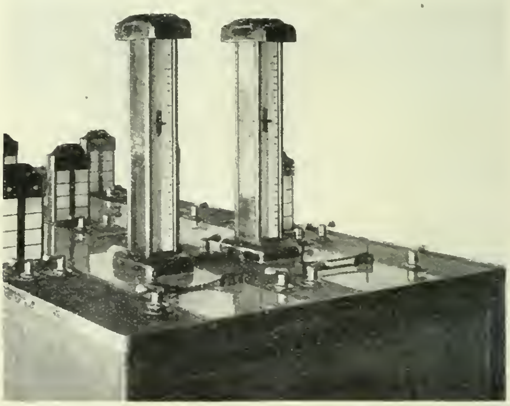


Fig. 3—Small part of centralized control board, Miraflores lock

of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the posi-

tion indicator, a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows.

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine similar to mechanism in Fig. 4. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack engages a gear on the rotor shaft and this turns the rotor as the gates operate. The mitering gate indicator comprises a pair of aluminium leaves, Fig. 1, shaped to correspond to the plan view of the top of the gate, which travel

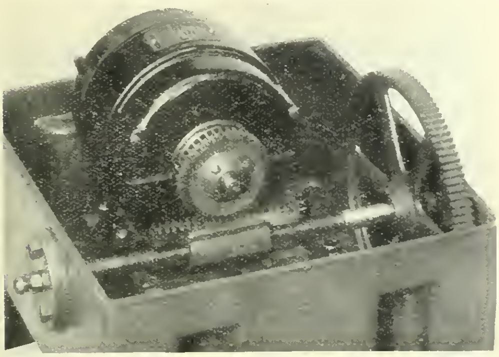


Fig. 4—Rising stem valve transmitter, cover removed

horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened, they are covered by shields to give the effect of the gates folding back into recesses in the lock walls. These operate on the board shown in Fig. 3 but are not included in the portion reproduced.

For the chain fender, the position indicator transmitter is driven by the shaft which operates the limit switch that controls the stroke of the piston. The indication on the board is given by a small aluminium chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board, see Fig. 3. The ends of the miniature chain are fastened to semaphore arms which are connected to segmental gears meshing with the driving gears on the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, see Fig. 3, a car being used to indicate the position of the valve gate. Both front and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½ and ¾ positions. (See Figs. 6 and 3). A small aluminium cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is located underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is always illuminated and the position above is dark.

The specifications covering the water level indication required an accuracy of 1/20 of a foot or 1/10 of 1 per cent. in actual water level In the transmitters and receivers for the machines described previously, the rotors turn less than 180 degrees with an inherent lag of 1½ per cent. between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water level indication.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180 degrees, or in twenty different positions for the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned more than one-half revolution with the power off. Therefore, the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions and the other set connected to a coarse index operating less than 180 deg.

The fine index (see Fig. 3, tall chimney-like structure) is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminium ball, representing the coarse index which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct within the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water level indication, wells 36 inches square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges contain a welded steel box float, 30 inches square by 9 inches deep. A non-slipping prosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control boards representing the machine.

Control boards represent locks in miniature

The control boards are of the flat top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs, see Fig. 3. The outer edge of the board is surrounded by a brass trim rail and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with nameplates for the "open," "closed" and "off" positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers and their cable connections (see lower half of Fig. 6). Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, receivers and the lamps that illuminate the scales of indicators. The receivers, transmitters and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25 cycle alternating current.

Mechanical interlocking system

In order to make it necessary for the operator to manoeuver the control switch handles always in a certain order,

corresponding to a predetermined sequence of operations of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with inerlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below (see Fig. 7).

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks. The interlock system is essentially a bell crank mechanism, connecting the shaft to the control switch through a movable horizontal bar to a vertical operating shaft which can or can not move according to the relative positions of the interlocking bars and dogs. The interlocking rack is a steel frame carrying five horizontal members, Fig. 5. Upon these and tying them together are vertical steel straps which carry brass runway posts for the vertical and horizontal interlock bars. These posts are riveted to the vertical steel straps, a thin brass plate between posts and straps making the runways non-corrosive. The vertical operating shafts are of square steel, turned on the ends, and work in brass bearings near top and bottom of the interlocking rack. Forked cranks mounted on the vertical operating shafts move the horizontal interlock bars by means of pivot blocks set over pin blocks riveted to the horizontal bar. The interlock bars and dogs are of special shape, hard, extruded brass, which section keeps the dogs in line with the axis of the bars when under pressure by being engaged with another dog on a vertical bar. Every control switch uses a horizontal bar from 3 to 50 feet long.

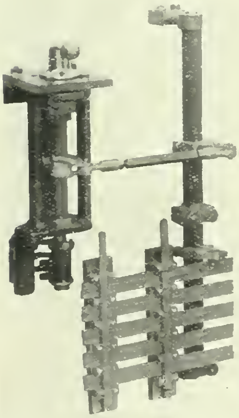


Fig. 5—Control switch and interlock mechanism

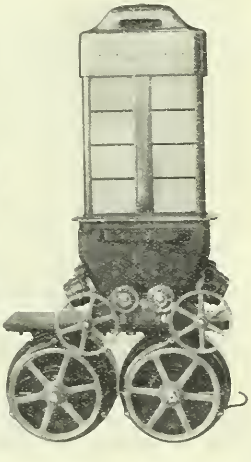


Fig. 6—Gate valve index for lock control board

The interlock system depends mainly on the action of engaging bevel dogs located on horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar can not be moved without raising a vertical bar. Thus if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages with the vertical bar can take place, and the control handle connected to that particular horizontal bar is locked.

Interlocks prevent the chain fender from being lowered until adjacent mitering gates have been opened, and also prevent the gates being opened until the chain is in the raised position. In this way it is assured that the chain fender will always be in the up position to protect the gate when the gate is closed. To avoid unnecessary complication, each end of the chain is interlocked with the leaf on its side of the lock only, because as a rule both leaves of a gate, as well as both ends of a fender chain, will be opened simultaneously, and further interlocking is unnecessary. After the mitering gates are closed a miter forcing machine is operated by a control handle and locks the ends of the gates closed. This machine cannot be operated until the gates are closed.

Also the rising stem valves of the side wall, next above or below a miter gate, must be closed while the miter forcing machine is open. As the miter forcing machine cannot be closed until the gates are closed, this means that the valves either above or below the gate must remain closed until the gate itself is closed, thus preventing the operator from creating a current of water around the gates while they are open, or being moved in opening or closing. This interlock is not included on the middle wall valves for the reason that they will be used with the locks on either side and must be free for that purpose.

Either pair of rising steam valves may be opened first, at the choice of the operator, an interlock becoming effective when the first valve of the second pair of duplicates is opened. This is done by a novel arrangement of equalizing levers acting against the ends of the interlock bars, with certain definite amount of lost motion which is taken up on opening the first pair of valves, thus putting the interlocks in operation on the next pair. To illustrate this operation, consider, for example, a side wall culvert at Gatun with its principal rising stem valves at each change of level from one lock to the next. The control of these valves is interlocked so that if the valves are opened at one particular point, the valves a lock length upstream or downstream cannot be opened. Thus the operator is limited to equalizing the water between locks and cannot allow water to flow from the upper lock past the middle lock into the lower lock, which operation, if permitted, might flood the lower lock walls and the machinery chambers in them. The cylindrical valves are interlocked so that if those on one side are opened the ones on the other side are locked closed, and the opening of one switch on a side will lock the opposite ten. This prevents careless cross filling between locks, which operation might be combined with the regular method and produce flooding. However, there may be times when it is desirable to employ cross filling to economize in the use of water from Lake Gatun in the dry season. For this reason this interlock is made removable by the use of a Yale lock and key. The key will be placed in the hands of the chief operator.

In the use of the middle wall culvert, the cylindrical valves on one side or the other must be opened before the rising stem valves can be opened, and the rising stem valves must be closed first. This interlock is applied in order to require the operator to control the flow of water by means of the rising stem valves rather than by the cylindrical valves.

In most cases the locks are divided into two unequal parts by the intermediate mitering gates. This arrangement makes it necessary to divide the ten cylindrical valves into two groups of seven and three, respectively, for the long and short lengths. A selecting lever is provided for these interlocks and may be set as indicated by a nameplate on the lever to "three," "seven" or "ten" respectively; whereupon the corresponding valves are subject to that interlock.

and the others of the group of ten are locked closed if three or seven only are to be used. The failure of the operator to make his selection properly in advance will simply cause him the trouble of going back and doing so, as the remaining valves are locked closed. This arrangement permits handling small vessels without causing waste of water due to operating such vessels in the large chambers. If a short vessel were being passed downstream, it would first pass into the chamber having three sylindrical valves. The group selective lever would then be placed on the "three" position which would permit the opening of three valves above the intermediate gate, but would lock closed the other seven valves above it. After the vessel had been passed below the gate the handle may be reversed releasing the lever and locking three switches.

Fig. 7—Interlocking system below the Miraflores board—Floor not yet installed.

There are intermediate rising stem valves ih the side walls at each intermediate gate, but no interlocks are applied to these for the reason that they will be used in a more or less irregular manner, and no fixed laws for their operation can be made in advance. Moreover, they control the water only between different sections of the same lock, and there is not the danger from mistakes in operation which exists in the case of the other valves which control water between lock levels. The same is true of the small auxiliary culvert valves, by means of which the space between the upper guard gate and upper main gate is filled and emptied.

In case a large vessel is to be locked through, the interlocks on the intermediate gates can be made ineffective by the operation of a Yale lock which uncouples a clutch and disconnects the central switch from the operating mechanism. Turning the key removes the interlock and permits the intermediate gates to be thrown open to obtain a 1,000-foot level and the valves operated independently of these gates.

To obviate the possibility of flooding the locks when valves are in a certain position, diagonal interlocking is introduced between the rising stem valves of the side wall and those of the middle wall a lock length away. This interlocking between valves diagonally across a lock when the cylindrical valves are open is needed to prevent the flow of water from, say, the upper lock by way of a side wall culvert to the middle lock, thence by way of the middle wall culvert to the lower lock, thus allowing an operator through carelessness to flood the lower lock walls. If the cylindrical valves of a certain lock are closed, the interlock is not needed on the rising stem valves of that lock; and since such interlock would interfere with the proper use of the valves of its twin lock on the other side of the middle wall, this interlock is automatically removed when all ten cylindrical valves are closed on the particular lock in question, and is automatically applied again if one or more of the ten cylindrical valves are opened. Furthermore, the valves of the side wall immediately at the gate which is being moved will be open to equalize water level, and diagonal interlocking will prevent the opening of the middle wall valves a lock length above or below the gate being moved. Each of the four valves of such a group has independent control, their control switches being so interlocked that either pair may be opened and left open as guard valves, the interlocks becoming effective when the operator tries to open the first valve of the second pair. In addition to these pairs of valves in parallel, each pair is duplicated at each change of level from one lock to the next.

Interesting manufacturing details

Nearly two thousand special drawings were required in the fabrication, and there were also involved the following unusual quantities of materials:

Special slate bases		1,300
Small castings		160,000
Screw machine parts		1,200,000
Copper rod and bar	ft.	58,000
Asbestos lumber	sq. ft.	9,000
New patterns		650
New jigs, templates, tools, etc.		625
Porcelain parts		18,000
Special bus supports		6,800
Galvanized pipe (framework)	ft.	21,000
Special gears		2,300
Special instruments		640
Miscellaneous sherardized pieces		300,000
Cases for boxing		4,150

The combined weight of the centralized control boards for Gatun, Pedro Miguel and Miraflores is about 39 tons.

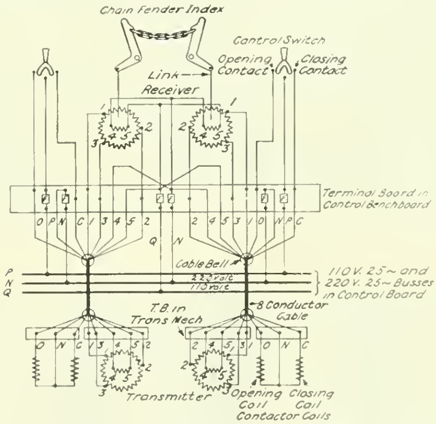


Fig. 8—Wiring for control switches and syncheronous position indicator for chain fender index

In their construction there is employed more than 2¼ miles of interlocking rod; about six million feet of control leads made up in 5 and 8 conductor cables; 732 indicator motors, 464 control switches.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line sub-station equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.

Welding Chain Links by Electricity

By Mr. L. B. Powell*

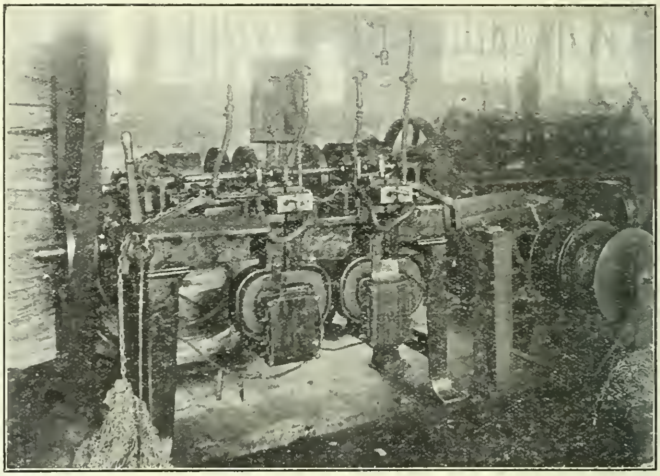
The electric welding of chain is a modern improvement, made necessary by the evils existing under the old style of manufacture. Chain above all other products needs the strength that is obtainable only by perfection of welding, and the invention of the automatic welding process is the result of experiments continuing over a long period of time, with a view to finding a method of forming and welding links that would result in every weld being absolutely perfect.

The machines illustrated herewith, reproduced from photograph of the McKinnon Chain Company's plant, are not the product of a chance thought bnt are the result of long study and expensive experiments resulting in continuous improvements, all of which are fully protected by patents in Canada, Great Britain, United States, and several European countries. The first operation in the manufacture of Butt Weld Chain is forming the chain into unwelded links on the forming machine shown in one of the illustrations. The coils of wire are fed into the machine from a spool and the operation of the machine is entirely automatic, linking the chain together ready for welding as shown. From the forming machine the unwelded chain is fed directly into welders of the type illustrated, the operation of which is entirely automatic.

Owing to the fact that alternate links present themselves for welding with the opening at different angles, these welders are constructed with two heads so that the first head will weld every other link and the second head will weld those in between, the chain being twisted between the first and second heads so that the link will be presented to the jaws of the welder in the same position. This arrangement is one of the patented features of these machines.

The electrodes of the welder meet the material on each side of the joint and, while the current is passing across the joint, the link is being given compression at the ends so that a junction of the material at the welding heat is being effected. The heat is developed by the passing of a large volume of current at a very low pressure (2 to 3 volts). The pressure is so low that the current cannot be felt even with both hands on the electrodes, while the volume is so great that ½-in. links come to a welding heat in 5 seconds and it requires a conductor or lead 8 inches square, of pure copper. A curious fact about copper used for such purposes is that one per cent. of impurity reduces its current carrying capacity by thirty-three per cent.

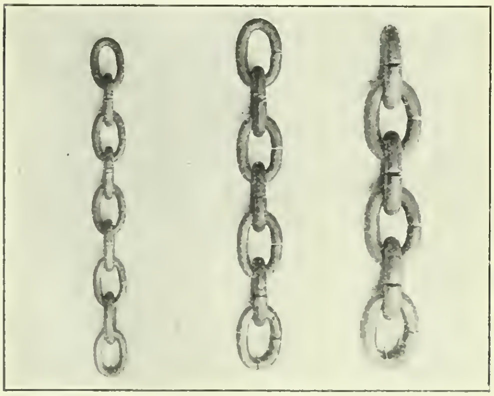
These welders are entirely automatic, with the pressure and current regulated so that each link receives exactly the correct amount to insure a perfect weld. This does away with the uncertainty of fire welding where the perfection of the weld is subject to the chances of want of skill or care on the part of the workman—burning or insufficiently heating the steel—and of dirt or sulphur in the fuel.



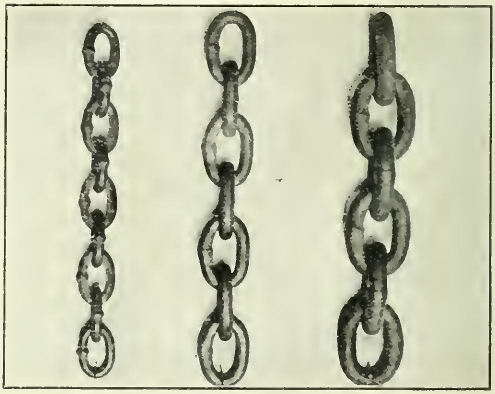
Welding chain links by electricity—The electrical equipment

One of the accompanying illustrations shows several sizes of chain just as they come from the welder and illustrates clearly the swell at the weld which is a feature of all McKinnon products. This swell is a natural result of the process of manufacture and while it could be reduced so that the weld would be equal in diameter to the balance of the link, such a reduction would not only take away the extra

* Sales manager, McKinnon Chain Co., St. Catharines.



Showing chain as it leaves the forming machine.



Showing chain as it comes from the welder.

strength where most needed, but would have a tendency to weaken the weld mechanically, and in both these ways would reduce the quality of the product.

The swell at the weld does not interfere in any way with the use of the chain for practically all purposes and a great many tests have proven absolutely that the reduction of the weld would mean a decrease of almost 50 per cent. in the strength and wearing quality of the chain.

While records show that over 99 per cent. of the products of these automatic welders is perfect in quality of welding, yet nothing is omitted that will produce as near to 100 per cent. perfection as possible. For that reason every link of chain is carefully inspected after it leaves the welder and any links that may show evidence of imperfect welding are at once cut out and the chain is passed to the hand welder to be joined together before being tested.

The McKinnon Chain Company state that theirs is the only weld chain being made in Canada and that during the five years that the product has been on the market it has come into almost universal use among the leading manufacturers and users of chain throughout the country.

International Electrical Congress

The International Electrical Congress is to be held at San Francisco September 13th to 18th, 1915, under the auspices of the American Institute of Electrical Engineers by authority of the International Electrotechnical Commission, and during the Panama-Pacific International Exposition. Dr. C. P. Steinmetz has accepted the honorary presidency of the congress. The deliberations of the congress will be divided among twelve sections which will deal exclusively with electricity and electricity and electrical practice. There will probably be about 250 papers. The first membership invitations will be issued in February or March, 1914. The meeting of the International Electrotechnical Commission wil lbe held during the week preceding that of the Electrical Congress.

Attention is drawn to the distinction between the International Electrical Congress and the International Engineering Congress, which will be held at San Francisco during the week immediately following the electrical congress. The engineering congress is supported by the Societies of Civil, Mechanical and Marine Engineers and by the Institution of Mining and Electrical Engineers, as well as by prominent Pacific coast engineers who are actively engaged in organizing it. This congress will deal with engineering in a general sense, electrical engineering subjects being limited to one of the eleven sections which will include about twelve papers, treating more particularly applications of electricity in engineering work.

A Substitute for Cement

In Turkey, where cement is not used or hardly known, a substitute has been found that has met with rather good results when applied in exposed places, in filling crevices in water pipes, covering joints in stone floors, in fountains, and for numerous other purposes where cement would be required. The mixture is as satisfactory in water as in exposed places, but it must be allowed to become thoroughly dry before it is submerged.

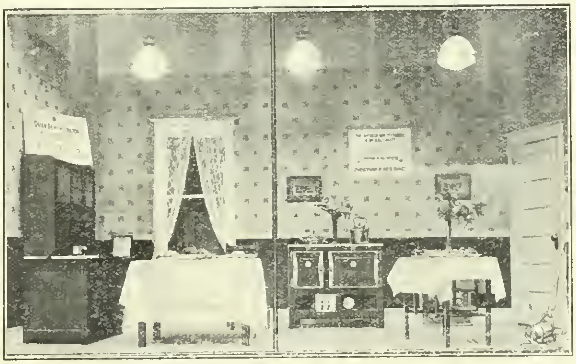
The mixture is slaked lime, linseed oil, and cotton fiber. Generally a hollowed-out stone is used, although a flat, hard surface will answer, and the process is started by pouring the oil on a handful of cotton, after which the lime is dusted in. It is then kneaded until the whole is thoroughly mixed and about the consistency of dough. The more it is kneaded the better it becomes.

This compound has undergone a severe endurance test at this consulate. Two years ago the stone floor in the balcony on the north side of the house leaked in several places and rotted the woodwork supporting the balcony. The floor was finally taken up, new timber added, and the stone flags again put down. Between each stone this mixture was forced in and smoothed over the joints. It took several days for hardening, the oil spread out on the stones for about half an inch from each joint, leaving a slight mark, but the compound soon hardened like cement, and today the surface over the part where the stones are joined is as hard and smooth and water-tight as if cement had been used.—Daily Consular & Trade Reports.

Window Decorations as Advertisements

The Toronto Hydro-electric Commission are paying particular attention to their window decorations as being one of the most satisfactory means of advertising electrical equipment. The Commission are fortunate in having a show room that is admirably located in that it is probably passed by as many prospective purchasers during the day as any other point in Toronto. The great care that has been taken with the demonstrations coupled with their frequent changes has made the Hydro windows a source of very great interest to the average citizen who makes it a point every time he passes to see what is new in the household supply business.

The particular exhibit shown here was in connection with a demonstration of electric cooking ranges. The window was fitted up as a model kitchen and demonstrations were given daily by a competent operator between the hours of 11 a.m. and 1 p.m. and 2.30 p.m. and 5 p.m. All kinds of food were cooked and a menu printed daily and displayed showing just what was being prepared. A blackboard was also placed in the window on which were written various cooking recipes and information relative to the ranges and their operation.



Display of electric stoves in model kitchen.

To prove the claims made for the wire drawn tungsten, the Toronto Hydro System recently installed in their show window a very ingenious device by which people were shown how really strong and reliable tungsten lamps are. The device consisted of a rocker arm which was moved up and down by an eight-sided fibre wheel, no two sides being exactly the same size. This wheel was driven by a small 1/8 h.p. motor equipped with belt and pulley. Ten sockets were provided in the rocker arm into which ten 25 watt 115 volt tungsten lamps were screwed. Two make and break contacts allowed the lamps to be alight all the time, and the display, according to Mr. C. H. Dudley, who has charge of the lamp and appliance department, drew big crowds to their window.

New Plant in Melville

The town of Melville, Sask., situated some 275 miles west of Winnipeg, the second divisional point on the Grand Trunk Pacific Railway, and boasting a population of nearly ,000, has just installed an electric plant, a brief description of which is given herewith.

The generating equipment of the station consists of two units. One is a Swedish General Electric 75 kv.a., 3-phase, 60 cycle, 2500 volt machine belted to a Daniel horizontal single cylinder, 4-cycle, 85 h.p. gas engine. The second unit is also a Swedish General Electric machine, 150 kv.a., 3-phase, 60 cycle, 2400 volts, direct connected to a Tangye vertical, 3-cylinder, 4-cycle, 220 r.p.m. engine. Both generators are of the revolving field type, Y connected, with exciters on the same shaft forming an integral part of the main machine. Each exciter is only of sufficient size to excite its own dynamo. The lubrication on both engines is manual except in the crank chamber of the larger machine, where it is of the splash and force feed type for inaccessible places.

The switchboard consists of six panels of white marble each 30 in. x 48 in. mounted on pipe frame. These comprise two generating panels with ammeters, volt meters, oil switch and automatic release; one panel for the main town feeder which feeds both power and light users for the whole town; two panels for the two 50 h.p. motors which operate centrifugal pumps and one 20 h.p. motor connected to a deep well plunger pump by means of a belt which is also connected to an air compressor, used in connection with the starting of the gas engines, and one panel for the constant current transformer used for street lighting purposes. There are no lightning arresters at all on the system, the feeders, after passing through the switchboard being brought out through the same opening in the side of the building. No regulator has been installed either at the station or on the line.

The local distribution is at 2400 volts carried on 30 and 35 foot white cedar poles with four pin cross arms. No. 6 and No. 8 B & S weather-proof copper wire is used throughout on primary and secondary. This, however, has been found to be rather small, which, combined with the lack of regulation equipment allows considerable voltage variation on the line.

The water for the town is obtained from a well 175 feet deep and the water is pumped into a reservoir by means of a deep well plunger pump operated by the 20 h.p. motor mentioned above. The high pressure equipment consists of two Stillman-Watson centrifugal pumps, each connected to a 50 h.p., 2400 volt, 3-phase, 60 cycle, Swedish motor. The piping is so arranged as to permit operation of these pumps either singly or in parallel.

The current charges in Melville are 14c per kw.h. with 10 per cent. discount if paid before the 12th of the following month. A straight 3½c rate for power is also given.

New Books

Publications reviewed under this head may be obtained, in future, direct from the publishers of the Electrical News.

American Electricians' Handbook—By Terrell Croft; McGraw Hill Book Co., Inc., publishers; price $3.00 net. This is a practical man's handbook. In compiling the matter the object has been to collect such information as will enable practical electrical men—wiring men, contractors, line men, small plant superintendents, operators and construction engineers to select and install commercial electrical apparatus and materials and to operate the equipment after it has been installed. A minimum of theory is given and theoretical discussions have been included only where absolutely necessary. Illustrations and diagrams—every one of which was specially prepared for this book—have been used very freely. A number of special problems are solved to indicate the application of the rules that are given. The handbook is attractively bound in pocket size and appeals to us as covering the field claimed for it better than any book we have previously seen. Especially the sections on outside distribution and interior wiring are practical and complete. The handbook includes six sections in all, as follows:—Fundamentals, Generators and Motors, Outside Distribution, Interior Wiring, Transformers, Illumination.

Insulation & Design of Electrical Windings—by A. P. M. Fleming, M.I.E.E., and R. Johnson, A.M.I.E.E. Longmans, Green & Company, publishers, and distributed in Canada by the Renouf Publishing Company, 25 McGill College Avenue, Montreal, agents for the publishers in the Dominion of Canada and Newfoundland; price $2.25. In this treatise the authors have endeavored to set forth the underlying principles and methods whereby the design of insulation can be carried out with precision, and have embodied the result of many years of practical experience in connection with insulation problems. Insulation is one of the most important parts of electrical machinery but the unmechanical nature and general unsuitability of commercial insulating materials for withstanding high temperatures and stresses has discouraged any very wide spread scientific investigations of directly practical applications. The present publication will therefore be studied with interest. The scope of the work may be judged from the following chapters:—(1) Physical Characteristics of Dielectrics; (2) Electrostatic Conditions in Practical Working; (3) Insulating Materials; (4) Design of Insulation and Winding; (5) Insulation Tests; (6) The Drying and Handling of Electric Windings; (7) Insulation Failures.

Elementary Graphic Statistics.—by J. T. Wight, A.M.I. Mech. E., Whittaker & Co., London, publishers; price 4s net. This is written in the form of a text book for students who may be in search of a working knowledge of the application of graphic methods to the solution of the simpler problems met with in engineering and building construction practice. The following headings indicate the scope of work:—(1) Composition and Resolution of Forces; (2) Simple Practical Problems; (3) Composition of Non-Concurrent Forces; (4) Bending Moment and Shearing Force Diagrams; (5) Beams with Rolling Loads; (6) Roofs—symmetrical—Dead Loads; (7) Roofs—Unsymmetrical Loading; (8) Roofs—Wind Pressure; (9) Braced Beams and Girders; (10) Centre of Gravity —Neutral Axis—Resistance Figures—Moments of Inertia; (11) Retaining Walls.

Village Electrical Installations—by W. T. Wardale, A.M.I.E.E., Whittaker & Co., London, Eng., publishers; price 2s net. This is a small book of some 80 pages containing chapters on the following topics;—(1) Why Village Schemes are Now Financially Possible; (2) Formation of the Company; (3) the Generating Station; (4) the Overhead Line; (5) the Choice of the Plant; (6) Capital and Running Costs of Various Plants; (7) the Switchboard and Battery; (8) House Service and Connections; (9) the House Wiring Department; (10) Methods of Charging by Meter or Contract; (11) the Man to Manage the Installation; (12) Hints on Running the Plant; (13) Taking Electricity from a Power Company.

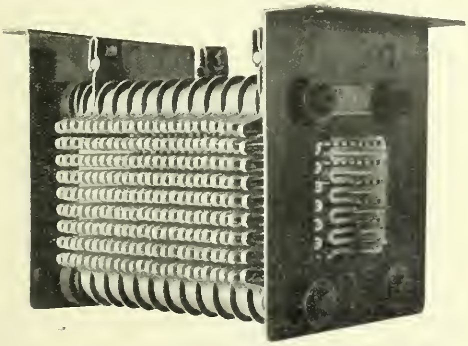
Among the Canadians included in the New Year's honor list is Henry Kelly Egan, of Ottawa, who is well known in electric circles, being a director of the Montreal Power Transmission Company and associated with the Ottawa and Hull Power Company. Sir Henry was born at Aylmer, Que., in 1848. He is connected with a number of important companies and is also prominent in connection with charitable and philanthropic work in Ottawa. Sir Henry has several times declined nomination for a seat in the House of Commons.

Electric Railways

A New Railway Rheostat

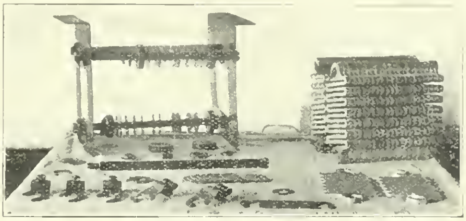
The Canadian General Electric Company have recently brought out a rheostat for railway service that is claimed to be superior, in construction, in case of replacing grids and in general reliability, to anything on the market. This is known as the R. G. type of rheostat and its general characteristics are stated to be: breakage of grids reduced; greater reliability; grids can be easily replaced; greatly improved insulation on tie rods and in washers throughout, in place of mica; less sagging and warping from overloads.

The improvement in reliability of rheostats for railway equipments depends largely upon making them so that there is less chance of grids becoming broken, short circuited, grounded or burned out under the heavy overloads which rheostats for railway service are subjected to. The most satisfactory material for grids as proven by tests and years of service, is cast iron of the best grade giving maximum strength and elasticity, coated with a special compound found to materially prevent rusting. The grids in these rheostats are shaped so as to be most serviceable, and are mounted between light pressed steel frames reinforced where the rods are supported in them. The grids have convolutions as short as is consistent with good engineering practice. Each grid is supported at two points; but the short convolutions and large cross section render them extremely rigid, thus eliminating the liability of breakage or short circuits due to vibration. Furthermore, the grids are so rigid that when suddently cooled after having been subjected to heavy overloads, they are not apt to break; a feature which in itself renders this type more reliable than others on the market for similar service.



Rheostat assembled.

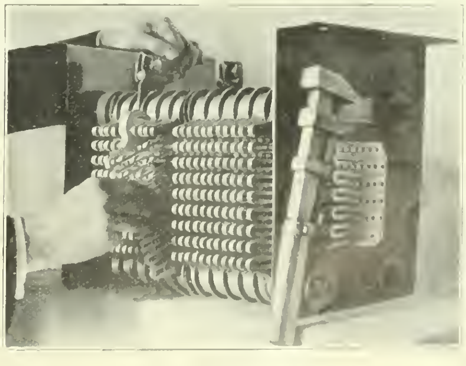
The use of a new form of insulation in place of mica for insulating the rheostat tie rods and for insulating washers used in this type of rheostat, has found most satisfactory in service on some of the largest railway systems in Canada. The greatest permissible creepage surface is used to insulate the grids from the supporting frame. Furthermore the grids are arranged in two sections; therefore there is only half the potential between any two grids on the same rod. While the insulation is sufficient for them to withstand all conditions of heat and weather, it is recommended that they be located in a position under the car where they will be reasonably free from wheel wash, which combined with brake shoe dust, tends to reduce the factor of safety of the insulation.



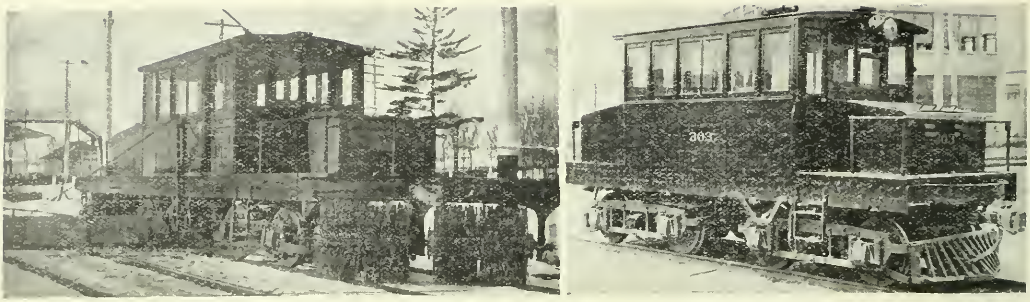
Rheostat dismantled.

After being assembled, each rheostat is given a complete and thorough test, including a potential of 5,000 volts applied between the frame and all of the grids. When supporting the boxes from the car, they may be readily insulated by mounting them on wooden beams, or by using insulated bolts.

In case of a grid being broken, it may be readily replaced without removing the rheostat from the car; thus saving the time which with other rheostats is required to discount, dis-assemble, assemble and again mount on the car. The grids are supported top and bottom by means of slotted lugs, and the openings are designed so that the grids cannot drop out but must be raised when removed. To replace a grid, it is only necessary to loosen the nuts of the supporting rods, when the grid can be removed and a new one inserted without the use of additional material.



Grids are easily replaced.



Combination sweeper, plow and locomotive in use by Ottawa Street Railway Co.

New Sweeper for O. E. R. Co.

The accompanying illustrations show a new all steel frame combination sweeper and snow plow recently built for the Ottawa Electric Railway by the Ottawa Car Company. The underframe of the new car is very rigidly constructed with 10-in. channel steel and strongly braced with lateral bracing. The cab is built of wood with steel panels.

This new car has several improvements over the sweeper which was built for the same company in 1912, these being (1) detachable ends by which means the brooms can be taken off or put on as required, (2) plows raised with worm and worm gear instead of the chain and drum gear, and (3) instead of having two large sliding doors which were located on each side in the centre of the cab in the former sweeper, the new car has one door near the end and a sliding sash at the centre of the cab from which the plows can be operated.

All the operating wheels for the brooms and plows are conveniently placed in the cab. The sweepers are mounted on Brill-27 F-E-2 trucks having 4 ft. 10 in. wheel base and cast iron wheels. Westinghouse straight air brakes are installed. The electrical equipment consists of four Westinghouse 101-B-2 motors mounted on the trucks and two Westinghouse 12-A motors located in the sloping steel housings at each end of the cab. These are connected to the broom shafts with Jeffrey detachable chains.

The sweeper is equipped with 2-K-35 controllers and one K-10 controller. The machine weighs when in use as a sweeper about 55,500 pounds. As seen from the illustration it can be used as a locomotive, 30-ton capacity, requiring very little ballasting.

Fort William's New Cars

The city of Fort William have recently received from the Ottawa Car Manufacturing Company, Limited, for their municipal system, four double truck all-steel frame, semi-convertible type p.a.y.e. cars. These cars are of the semi-convertible type, have an all-steel under-frame and side construction, and are fully equipped with rattan upholstered seats, pantasote curtains, Forsythe curtain fixtures, incandescent lighting system, hand brakes, draw bars, alarm gongs and other fittings standard on cars of this type.

They are also equipped with special appliances as follows: Brill No. 27-G-1 trucks with standard hot rolled steel axles and chilled iron wheels; Westinghouse quadruple No. 101-B-2 motor equipments with K-35 controllers and other accessories; Westinghouse schedule SM-1 air brakes, H. B. life guards; "O. C. Manufacturing Company" track sanders; Consolidated Car Heating Company buzzer signalling system; Peter Smith "coal fuel" hot air heating and ventilating apparatus and Crouse-Hinds arc headlights.

While the exterior of these cars up to the roof line is of steel construction to stand the wear and weather, the interior finish including all window sash and doors is of cherry, natural color, and highly polished; all interior trimmings such as sash and door locks, grab handles, etc., are of solid cast bronze, polished finish.

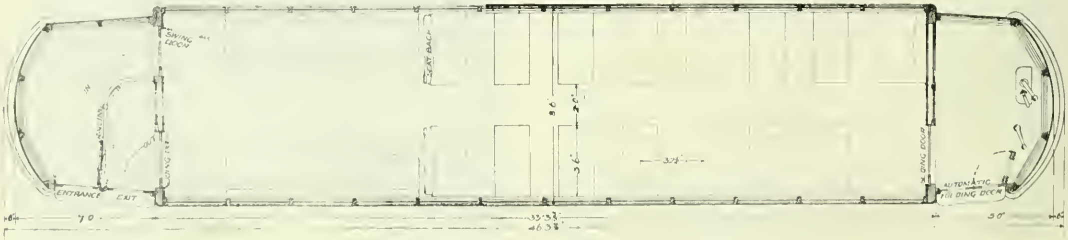
The roof is a composite wood and steel construction, monitor type, covered on the outside in the usual way with heavy cotton duck, stretched in white lead and oil paint. The interior of the roof is finished with three-ply wood veneer head-linings and painted.

On the whole, these cars are of a very high quality, and being very graceful in appearance they may be considered as being equal to any, of their type, on the continent.

The general dimensions are as follows:—

Length over bulk-heads	33 ft. 6 in.
Length of front vestibule	5 ft. 0 in.
Length of rear vestibule	7 ft. 0 in.
Total length over bunters	45 ft. 3 in.
Width over side plates	8 ft. 6 in.
Seating capacity	40 persons

General manager Sperling of the B. C. E. R. Company recently stated that the earnings of the tram lines, considered as a separate undertaking, only averaged in the neighborhood of 2 per cent. on capital investment during the past year.



Plan of new cars recently placed on the lines of the Fort William municipal system.

Illumination

Illuminating Engineering in 1913

The year of 1913 witnessed a great awakening in Canada's industrial and mercantile worlds for a higher standard of illumination in the factory and store. The interest so awakened going beyond the demand for "lots of light," to a desire for the proper amount of light, the quality best suited for that particular requirement, and the correct placing of, and treatment of, the units to eliminate any objectionable features, such as glare or other fatiguing effects on the eye.

That the continuous operation of the modern industrial plant involves a very liberal use of artificial illumination is strikingly demonstrated by reports, giving the average hours per day of sunshine, cloudiness and darkness for each month, during an entire year. Reports compiled for the city of New York during the year 1910, show the following conditions that prevailed there:—sunshine 32.3 per cent., cloudiness 19.1 per cent., darkness 48.6 per cent. With slight variations these figures will doubtless hold for any year throughout Canada's manufacturing centres.

The maximum output of an industrial plant is possible only under perfect operating conditions. No firm, however well established and prosperous, is pursuing the best business policy, if it fails to pay attention to every detail that makes for higher efficiency. To the manager who is intent on increasing the productiveness of his establishment, improved illumination means three things, more work, better work and greater safety on his operating floors; in other words, increased production, profits and welfare.

In commercial lighting rapid advances have also been made and many of Canada's largest retail establishments have, during 1913, changed their lighting systems from the old obsolete types to the newer ideas of today; this not alone promoting a better illumination but greatly enhancing the beauty of the stores, adding generously to their attractiveness.

Another field that has given recognition to the splendid work of the illuminating engineer, has been that of the church. The older types of church lighting that have caused so much eye discomfort are fast disappearing, and under the guidance of the lighting expert, installations are being made that permit of rare artistic effects, without being trying to the eye. This is also true in the lighting of the home.

Many central stations are also working along illuminating engineering lines, having established a special department to this end, or co-operating with the lighting experts associated with the manufacturers of globes and reflectors, essential in this work.

Another important recognition of the value of the work of the illuminating engineer has been by the press. Trade periodicals have devoted many pages to articles on various lightings scientifically installed, and are eager for further information in this direction.

Indications point to a larger development in the field of work for 1914 as new lamps of greater efficiency are soon promised, and the nature of this light source will make it imperative that some globe or reflector be used to diffuse its intensity and promote a greater useful illumination on the working plane.

For a field of work that is still in its infancy, and that has largely, up to the present time, been advanced by the manufacturers, to indirectly promote the sale of their materials, we can predict a big future. Great credit must be given these manufacturers for the work so far accomplished and the arousing of such interest in this comparatively new field of work. During the year tremendous advances in what might be called "specialized manufacture" have been made, so that every different requirement in the lighting field—the home, the factory, the store, the show windows, etc., is now treated independently and almost scientifically.

The Illumination of Burwash Hall

Much has been said and written about artistic electric lighting and its application to various styles of architecture, but it is noticeable that this is chiefly in catalogues of the manufacturers of lighting fixtures and there are few illustrations of actual installations one can call to mind where the ideas conceived by the architect have been carried on and out by the electrical engineer and contractor. This is largely

Section of main dining room—Burwash Hall.

the fault of the architect who does not lay sufficient stress on the importance of the correct design and plan of the illumination and who is often content to designate the location of the various outlets roughly, leaving the choice of design and the method of installation to the electrical contractor, whose desire to supply a correct illumination is often thwarted by a lack of foresight, both as to efficiency and effect, on the part of the designer. This is seen in the placing of outlets in the wrong positions, with too few of them and without, generally, provision for proper control. As a result there are comparatively few examples of Adam brackets, Louis XVI.

pendants, Georgian table portables, etc., properly applied, and the application of correct practice in the illumination of a public building is specially worthy of mention.

In the illumination of the new Burwash Hall building of the University of Toronto we seem to have a rare exception in that the architects, fixture designers and electrical engineers have got together with very happy results and we reproduce some photographs which indicate not only the artistic design of the interior of this building, but the pleasing harmony which prevails throughout in the fixtures and decorations. One can see that the design of the fixtures has received the same careful attention as the design of the other parts of the building with the result that although these fixtures are striking and attract immediate attention there is nothing in them that offends one's ideas of harmony or displeases the most aesthetic eye.

The most impressive fixtures are those in the main dining hall. Hanging from the centre are two electroliers consisting of three tiers of lights, the lights being hung by short chains from three bands of iron, diminishing from five feet diameter in the top band to two feet in the bottom, the bands being hung from each other by chains, and the whole being supported from a central corona by the same means.

The metal is of wrought and cast iron throughout, and the design is very severe, as becomes the period. The applied ornament consists of the Tudor Rose, interposed with Tudor shields, and a beading of twisted iron running round each band. Everything is designed in strict accordance with the period, even to the iron chain which is of rectangular link pattern in keeping with the rest of the fixtures.

On the walls are brackets consisting of semicircles of iron having the same applied ornament on a small scale, the lights hanging from the semicircle in the same manner as in the large fixtures.

The reflectors are all of satin finished glass, of a "bell" pattern, the lines being very simple and severe.

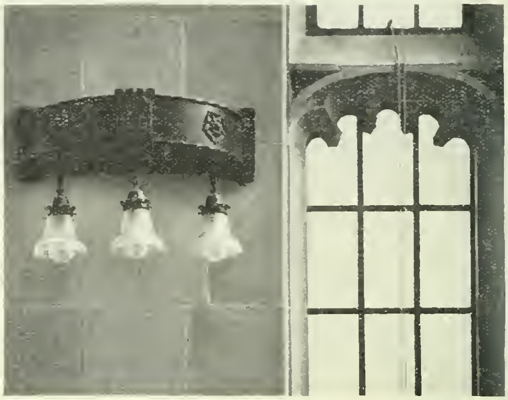
In the common-rooms are iron pendants of the semi-indirect type consisting of a satin finished glass dish hung in

Wall and hall fixtures—Burwash Hall.

an iron band supported from the canopy by twisted rectangular iron rods, the whole being in keeping with the general design of the building.

Practically the same type of fixture is carried through all the other rooms, slight modifications only being made to suit varying heights of ceiling, etc.

As we have said before, the general impression obtained on looking through the building is that the architects and fixture designers have got together with the best possible results, and have admirably succeeded in introducing the most



A handsome wall bracket in keeping with the architecture.

modern form of lighting into a building of possibly the 12th century, without any apparent anachronism.

The fixtures were selected by Messrs. Sproat & Rolph, the architects, from designs by Veritys, Limited, of Covent Garden, London, England, and were supplied and installed by Messrs. R. A. L. Gray & Company, of Toronto.

Edmonton's Telephone Extensions

The Edmonton municipal automatic telephone system has been making rapid strides during the year 1913, as will be seen by the statement appended.

The first eleven months show an increase of 2,826 phones over the previous year. The revenue for the year 1912 was $100,773, while the estimated revenue for the year ending December 31, 1913, is $195,000. The capital invested in the telephone department in 1912 was $862,074, for 1913 it will be approximately $1,800,000. Work is at present in progress on the laying of 11,100 miles of underground cable pairs, and it is expected that this will be completed in February. This big programme of work is the largest ever undertaken in the history of the telephone department and when completed there will be sufficient main feeder cables laid to take care of the districts of Norwood, Parkdale, Cromdale, Fairview, Woodland, that portion of Delton south of Delesare Ave., Eastwood, Mount Lawn, Santa Rosa, North Edmonton, Bellevue, Highlands and Virgina Park. The territory lying between Churchill Ave. and the C. N. R. tracks and the eastern portion of Glenora have also been amply provided for. These extensions are being made with a view to taking care not only of the present needs of the department but also of forming a part of the legitimate telephone plant of the city when it has reached a population of from 150,000 to 200,000. There has recently been completed in the switchboard department a 500 line addition in the north exchange, making a total of 1500 lines now available in this building. It is expected that by February there will be 1800 lines in this building. Early in March 500 additional lines will be ready for use in the main exchange and this will make a total of 5,500 in this building.

With all these lines installed and ready for service there will be a total of 10,800, or enough, it is estimated, to take care of the growth of the department during the year 1914.

The Dealer and Contractor

Get into the Bigger Field!

According to the records published by the Society of Electrical Development the salesmen of electrical supplies waste their energies in price-cutting competition to obtain a small percentage of the total business available and take no cognizance of the larger percentage of business that is going to waste for the lack of a little nursing. This is true, we believe, in the electrical contracting field quite as much as in any other line of the electrical business. The average electrical contractor or supply man waits until he hears that a certain business man has decided to install some kind of equipment or improvement, such as wiring or lighting additions. This process of coming to a conclusion is a slow one and has not been left to develop itself in any other line of trade. For example, what would we think of a life insurance company who opened an office and then sat down waiting for customers to come in and request them to place insurance on their lives. According to statistics the number of people who do this is considerably less than one per cent. of the total business written in any year. It is not easy to understand why the electrical contractor expects to do his business in a manner very much different from the life insurance company. There is a splendid unworked field in practically every town and city throughout Canada where some electrical product or other has only been sold to a very limited extent. For example, there are few sections where there are not a number of old houses waiting to be wired, and the investment of a few hours convincing the owners of the value of this modern convenience would be much more profitably spent than the present practice of cutting prices on a job of the same size in a new house. This is only one example of the line along which development in salesmanship might readily be shown.

This matter is very tersely discussed by Mr. J. T. Marron, in a recent issue of the National Electrical Contractor, who feels that there is more room for development in districts and along lines that as yet have been practically untouched. In this connection the following extracts from Mr. Marron's remarks are of interest,—

"The field for the average electrical contractor to-day is larger than it has ever been in the history of the electrical game. Statistics, furnished by the National Electric Light Association, show that there is less than one-third of the buildings in the United States wired for electric lights, and I can state without fear of contradiction that 75 per cent. of those wired are improperly lighted and no intelligent scheme of illumination has been worked out.

Now if this is true, let us analyze the contractor's field. He has 90 per cent. of the present buildings to work on for either wiring or proper illumination without touching the field of current consuming devices, which is very large and if properly handled the profits are very satisfactory.

We find that the average contractor waits for some one to come and ask him to wire an old house and then he goes out and figures it as low as possible, always assuming that his client will get another figure and will give it to the lowest bidder, and with this idea always in view he figures to put in as little as possible and never loses sight of the price end of it. The consequence is that a great many of the honess and buildings are wired improperly.

I find also that the average contractor will chase for two miles to figure on a new house in competition with ten other contractors who are after the same job, and on his way will pass fifty old houses which are good live prospects and with a little work could be gotten without any competition.

If the contractor would devote as much time in creating business as he does to figure competitive business, or, in other words, specialize and become expert in one branch of the business, knowing all that he could possibly learn about this branch instead of trying to cover the whole field promiscuously and try to figure everything that comes his way, he would be more liable to succeed in a financial way.

With the tremendous field that all electrical contractors have before them in which to work out their own salvation, there is no excuse for them not making money if they will go out and create work instead of fighting for the work already created.

I would sum up the field for the average electrical contractor as follows:

Every old house not already wired, every old building not already wired, every old building not properly wired, every good farm home for a farm lighting plant, every factory that uses power for motors, every large building for stationary vacuum cleaner, every retail store for remodeling its present lighting system and installing proper illumination, every present user of electricity for modernizing fixtures and arranging for proper illumination, the sale of mazda lamps to replace all carbon lamps, arc lamps, Nernst lamps, gas arcs and all the other kind of lights, the sale of electric irons, washing machines, percolators, toasters, fireless cookers, fans, water heaters, and all other electric devices for the comfort of the home give ample opportunity for successful effort.

You, Mr. Average Electrical Contractor, look over this field and see if you cannot spend your time more profitably selling something at your price in the field mentioned than figuring how you can take a job already created from your competitors. Wake up! Be one of the creators of business instead of one of the grabbers of low price jobs."

Canadian Krantz in New Quarters

The Canadian Krantz Electric & Manufacturing Company, Limited, announce that they have now established a factory in Toronto which is expected to be in full operation during the present month. It is the intention to manufacture in Canada panel boards and cabinets, switchboards, knife switches, water-tight floor boxes, etc., along lines similar to those now followed by the parent company in New York. Among the products will also be a new panel known as the "safety" type, which, it is said, has met with much favor. The company are now occupying their new offices at 67-71 Adelaide Street West, where Mr R. H. Nesbitt is in charge.

New Equipment for W. E. R. Co.

The Winnipeg Electric Railway Company have just installed twelve oil-cooled transformers of 1000 kv.a. capacity each. These transformers, as will be noted from the accompanying cut, are of the external pipe or "tubular" type, having boiler plate tanks into which a double set of pipes are welded by the oxy-acetylene process. The transformers are filled with No. 8 transil oil, which has a low viscosity, being practically a mineral seal oil, but possessing the added qualities of uniformity of characteristics and an absence of deposit even when subjected to continued excessive temperatures. The low viscosity insures rapid circulation of the oil downward through the external tubes where the heat of the oil

1000 kv. a. unit for W. E. R. Co.

is quickly dissipated. These transformers were supplied by the Canadian General Electric Company.

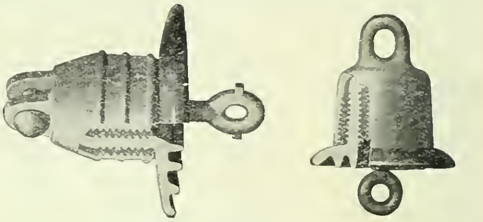
This type of tank, although new to Canada, has been quite widely used by the General Electric and other companies in the United States, and its use has extended the field of oil-cooled transformers from approximately 750 kv.a. to 2500 kv.a. Even larger units of this type could be built, but in sizes much above 2000 kv.a. the cost curve runs up sharply and, in comparison with water-cooled transformers, becomes practically prohibitive. Oil-cooled transformers above 2500 kv.a. up to approximately 4000 kv.a. can, however, be built economically by resorting to the use of external radiators (similar to the familiar steam radiator) around the outside of the boiler plate and piped to the tank at top and bottom.

The Winnipeg transformers are of Shell Type construction and are designed for service on 5500 volt circuits, six units having 22,000 volt and six having 2,200 volt low tension windings. They are provided with separate trucks and with a capillary tube dial type thermometer.

New Types of Porcelain Strain Insulators

To meet the severe requirements due to the increasing weight of overhead construction, two new types of porcelain strain insulators have been developed by the Westinghouse Electric & Manufacturing Company. These are a combination of a metal cap to give the necessary strength and a porcelain skirt to furnish the required dielectric strength.

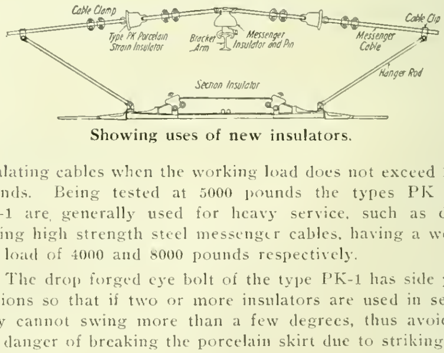
The metal parts of these insulators consist of a malle-



New types of strain insulators.

able iron cap, a drop forged steel eye bolt, and a malleable iron sleeve by which the eye bolt is securely fastened. The metal and porcelain parts are cemented together with a high grade Portland cement. The cemented surfaces are provided with carefully determined corrugations which prevent failure, except by the actual shearing of the cement. The skirt of the porcelain is provded with corrugations on the under side to give additional creepage surface.

Two types of these insulators are made, the PK and the PK-1. The metal parts of the type PK insulator are sherardized and those of the larger size, types PK-1, are not galvanized. The type PK insulator is especially used for



Showing uses of new insulators.

insulating cables when the working load does not exceed 1600 pounds. Being tested at 5000 pounds the types PK and PK-1 are generally used for heavy service, such as dead ending high strength steel messenger cables, having a working load of 4000 and 8000 pounds respectively.

The drop forged eye bolt of the type PK-1 has side projections so that if two or more insulators are used in series they cannot swing more than a few degrees, thus avoiding the danger of breaking the porcelain skirt due to striking the cap of the adjacent insulator.

Large Number of Isolated Plants.

An estimate appearing in the current issue of the Isolated Plant states that 63 per cent. of New York's big buildings, in number, and 78 per cent. in value make their own electricity. This is the result of a canvas of 154 buildings with an aggregate value of $497,357,000, or an average of more than $3,000,000 each. The smallest building had a value of $475,000. The following classification of the percentage of each type of buildings is interesting:—of 2 railway stations 100 per cent. have their own power plant; of 27 hotels 96 per cent.; 68 office buildings and stores, 72 per cent.; 7 club houses, 57 per cent.; 14 banks, 57 per cent.; 24 apartments, 37 per cent.; theatres, none.

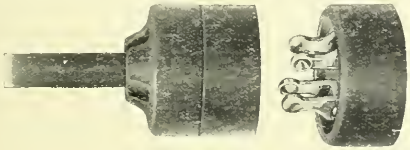
Commutator Troubles

Experience has proven that a commutator kept clean and properly lubricated will give much greater output with less heating than one which is neglected. A clean commutator prevents sparking and loss of power and increases the life of the brushes. Care should also be taken not to over lubricate as this, instead of increasing the output, decreases it by increasing the resistance between the commutator and the brushes.

Messrs. Saunders & Wainwright, 204 St. Nicholas Building, Montreal, have placed on the market a pad saturated with a special high grade compound which makes it impossible to over-lubricate or to lubricate without first cleaning the commutator. These pads are claimed to produce that desirable hard face and gloss on the commutator, reduce the friction to a minimum and ensure better contact. Another interesting line handled by the same firm is non-corrosive and non-conducting soldering fluxes. These are compounded to meet the needs of builders of generators, and are suitable for the soldering of all metals except aluminium. The Toronto representatives of this firm are the Electrical Maintenance & Repairs Company, Limited, 162 Adelaide St. West.

New Motor Attachment Plug

The extensive and increasing use of portable and small motor-driven devices such as vacuum cleaners, grinders, floor polishers, compressors, etc., has created a demand for a separable type motor attachment plug that can be permanently secured to the motor frame. A new motor plug recently designed by The Cutler-Hammer Manufacturing Company, shown in the accompanying illustration, is made for this purpose. The base can be permanently secured to the motor



A new motor plug

frame and this carries the rugged double lugs which are like those used on the caps of the standard line of C-H attachment plugs. These contacts are dead when the device is not in use, while the live contacts of the part attached to the flexible cord are sunk in below the surface.

Rugged heat-resisting "thermoplax," having proven itself adapted for plugs, is used in the construction of this plug which has the high rating of 10 amperes, 250 volts. The design of the heavy double lugs and contacts permits of separating the plug by a pull at any angle, a feature which is considered of considerable advantage in separable attachment devices. The Underwriters' Laboratories have given their approval.

The illustration herewith is the first of a weather proof line of Shurlok devices being manufactured by Pass & Seymour, Inc. The socket is of their well known mica compound type and supplied with the effective method of locking the lamp now so characteristic of this company's products.

"Gang" Type of Pipe Taplets

A new type of pipe taplet has been designed by the H. T. Paiste Company, which is calculated to decrease the labor and material cost of iron conduit work in many places. They are of special value when the wires of several different circuits run for some distance in the same direction, and are controlled from the same point. Instead of using 2, 3 or 4 conduit lines all the way from the distribution box, the wires for all the circuits are carried in one conduit from the distribution box to the point where they separate. At the control point a "gang" type pipe taplet is used which will take 2, 3 or 4 switches. If desired, one or more of the openings may be used for lamp receptacles or plug receptacles.

Special "X" and "T" types of pipe taplets have been designed for the points where the circuits branch off from

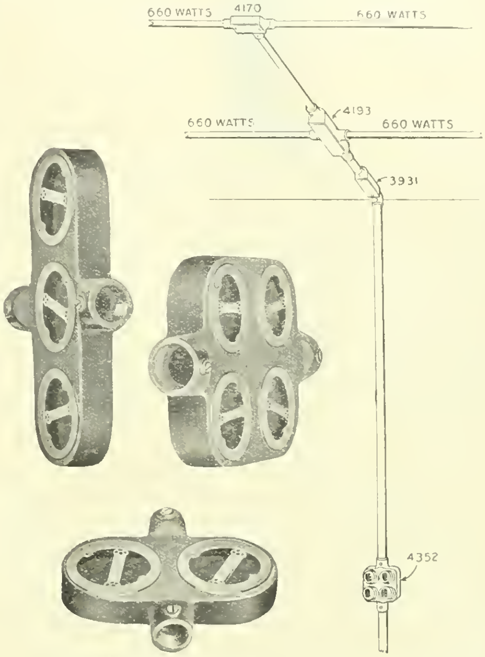


Diagram shows wires for 4 lighting circuits run in one conduit. Two, three and four gang taplets shown

each other. At the first point of separtion, as shown in the sketch, the best fitting is the No. 4193, which reduces from a 1 inch main to a $\frac{3}{4}$ inch main and has $\frac{1}{2}$-inch branches. A larger similar fitting (not shown) is No. 4194, which reduces from a $1\frac{1}{4}$-inch main to a 1-inch extension and has $\frac{3}{4}$ inch branches. At the second point of separation is shown No. 4170, which reduces from a $\frac{3}{4}$ inch main to $\frac{1}{2}$ inch branches. Not only is the cost of conduit and taplets on this line just about half the cost of running four separate lines of smaller conduit, but the labor cost of cutting, threading and fitting is reduced by more than half.

The Renfrew Electric Manufacturing Company, Limited, recently commenced the manufacture of small electrical appliances such as irons, toasters, disc heaters, radiators, coffee percolators, etc. The company is composed as follows:—T. A. Low, president; Dr. S. H. Murphy, vice-president, Dr. Conolly, J. A. Jamieson, and W. J. Guest, directors. Mr. Chas. E. Breckenridge is manager, and Mr. R. P. Moodie is mechanical superintendent.

New Condulets

These condulets are for use with portable telephone equipments and designed for housing telephone jacks. The support for the jack is mounted on a gasketed metal cover, from which it is properly insulated. When the plug is removed, a lid automatically closes the opening and prevents the entrance of dust, moisture or insects.

Type "TJ" condulet is intended for use under the body

Type "TJD" Condulet.

of a railway car. It has a swivel base which allows the plug to pull out easily when the car is moved. An insulating bushing is provided, through which the wires pass to the interior of the car.

Type "TJD" condulet is intended for mounting on poles or buildings along the right-of-way of a railroad, transmission line, canal, etc. The line wires enter the condulet through a ½-inch Obround 2-wire hole porcelain cover.

These condulets are manufactured by the Crouse-Hinds Company and take either the Northern Electric or the Stromberg-Carlson jacks.

Miscellaneous

The corporation of the city of Calgary have awarded a contract to the Swedish General Electric Limited, through their Canadian agents, Messrs. Kilmer, Pullen & Burnham, for a motor-generator set comprising one 1500 h.p., 2200 volt 3-phase, 60 cycle, 400 r.p.m. auto-synchronous motor with direct connected exciter connected by means of a flange coupling to a 1000 kw., 600 volt, compound wound, inter-pole type, d.c. railway generator. This set is an exact duplicate of the one supplied by the same company early last year. The contract includes the erection of the apparatus and all necessary cables from the motor generator set to the switchboard.

Mr. G. M. Gest has finished the two contracts for building conduits for the Montreal Electrical Service Commission. The commissioners are working on plans for other conduits, but no contracts will be given out until the spring.

Trade Publications

Wiring Material—Illustrated catalogue and price list of standardized wiring material manufactured by the H. T. Paiste Company, Philadelphia.

Modern Switchboards—Catalogue issued by the Canadian Union Electric Company, Limited, 122 Wellington St. West, Toronto. This catalogue is splendidly illustrated and covers the field of switchboards under the headings low tension, mining, high tension, desk pattern, etc., very completely.

Wires and Cables—A handy vest pocket, leather bound booklet issued by the Canada Wire & Cable Company, Limited, Toronto, being a catalogue and handbook of electrical wires and cables. This booklet contains a quantity of useful tables and information which the electrical man will find very useful to have constantly by him.

1914 Diary—The Siemens Company of Canada, Limited, are distributing a very handsome diary for 1914. This diary is a handy pocket shape with pencil attached and is bound in an attractive red morocco. In addition to the diary proper, the booklet contains a quantity of interesting illustrated information regarding the varied products of the Siemens Company.

The Simplex Manual.—On the press, for the Simplex Wire & Cable Company, Boston, is a 92-page booklet, which "just fits the pocket" as well as, it is claimed, the needs of every electrical man who has anything to do with wiring problems. It is full of tables and other information of different kinds about insulated conductors and other matters electrical, and is equipped with an unusually complete index.

New Companies

La Compagnie Electrique de L'Epiphanie Limitee.

Compagnie Electrique de Sainte Edwidge Limitee, St. Edwidge.

La Compagnie de Telephone de Windsor of Windsor Mills, Que., has been incorporated.

Electric Patents, Limited, has been incorporated with capital $10,000 and head office Vancouver.

The Western Cedar Pole Company has been incorporated with capital of $50,000 and head office Calgary.

The Two Miles Falls Water Power Company is seeking incorporation. The head office will be in Sherbrooke, P.Q.

The Metropolitan Electric Company, Limited, has been incorporated with capital $10,000 and head office Vancouver.

The Beaver Coal & Power Company has been incorporated with head office at Montreal and capital $1,000,000. The incorporators are F. H. Markey, W. W. Skinner, G. G. Hyde.

The Caughnawaga Light, Heat & Power Company, Limited, has been incorporated with $50,000 capital. The names of T. M. Jacobs and J. Curotte are connected with the incorporation.

Under powers of incorporation granted at Quebec, a company called the Star & Hydro-electric Company, Limited, has been formed for the purpose of carrying on business as electricians, at Cote St. Luc, P.Q., with power to develop the necessary water power for business in the counties of Soulanges and Beauharnois and to supply electric light and power to companies or corporations. The capitalization is $399,000. The company is composed of F. Wilfrid Themens, J. E. Archambault, Charles David Fagerberg, George Edward Antrobus, and Louis Phillippe Fournier, all of Montreal.

Personal

Mr. Julius G. Koppel has been appointed electrical superintendent of bascule bridges, C. P. R. system, with headquarters at Sault Ste. Marie.

Mr. C. J. Wright, secretary-treasurer and general manager of the Eastern Townships Telephone Company has resigned. Mr. Wright has been connected with the telephone business in the eastern townships for nearly 20 years.

Mr. Beaudry Leman has been appointed general manager of the Hochelaga Bank, Montreal. Mr. Leman is an engineer by profession, and at one time was a member of the Montreal Electrical Service Commission. In 1906 he was in charge of the construction work of the Shawinigan Water and Power Company, which was interested in electrical enterprises. In 1912 he entered the banking business.

Current News and Notes

Amherst, N.S.

The Canada Electric Company, of Amherst, N.S., have prepared plans for a 1,000 kw. turbo-generator set for installation at Chignecto.

Berlin, Ont.

The Hydro-electric Power Commission of Ontario have notified four rural districts that the cost to them of 50 h.p of electric energy would be as follows:—St. Jacobs, $29.08 per h.p.; Conestogo, $36.59; St. Clements, $42.68; Floradale (40 h.p.), $51.57. These municipalities would be served from Berlin.

Barrie, Ont.

A by-law was passed on January 5 authorizing the construction of an electric railway to connect Barrie with Midhurst on the C. P. R. and give local street railway service.

Brantford, Ont.

Following the legal disputes over the Brantford Street Railway system it is understood that general manager Kellett, of the Lake Erie & Northern Railway System, has made an offer to purchase and operate the Brantford Street Ry.

During the next year debentures to the amount of $104,611 will be issued to pay for the electric construction work at present under way.

Calgary, Alta.

The city commissioners have closed a contract with the Bowness Estates Company under which the latter agree to supply power for the operation of the Bowness line of the Calgary street railway system for a term of three years at a rate of 2c per kw.h. This will remove the necessity on the part of the city of Calgary of installing a regulating equipment at the end of this line.

Dome Lake, Ont.

The Dome Lake Mining & Milling Company have closed a contract with the Northern Ontario Power Company for the supply of 400 h.p. of electric energy. The mining company have already placed their orders for the necessary equipment. It is understood the Dome Lake directors have decided to retain their old steam plant for auxiliary purposes.

Edmonton, Alta.

On January 1, 1914, a new schedule of telephone rates became effective as follows:—single trunk lines, including one automatic phone, $40 per year; two or more trunk lines with the same number of automatic telephones, $30 per year per telephone; extra automatic telephones connecting to private branch exchange, wall type $10, desk type $13; extra manual telephones, wall or desk, $8. Rental of switchboard less than ten line, cordless type, $38.50; 10 to 20 local lines, $91; 21 to 40 local lines, $115; 41 to 80 local lines, $167; 81 to 100 local lines, $215; 101 to 150, $265; 150 to 200, $300.

Embro, Ont.

There is an agitation at this point for a supply of Niagara Falls power.

Edmonton, Alta.

The estimated expenditure for the year 1914 in the city of Edmonton includes $500,000 on extensions to the electric power plant. A new power house will probably be built and one or two new units installed in it. Considerable expenditure will also be made in the electric light and telephone departments, though this will not be as heavy as in 1913. Economy will also be practised in the street railway department, where only approximately $50,000 will be spent.

Fort Frances, Ont.

A telephone commission has been appointed consisting of Messrs. C. J. Holland, J. P. Wright, and P. A. Smith. Some time ago a contract was awarded for the installation of a magneto telephone system. This will have a capacity of three hundred lines.

Fort William, Ont.

At the annual meeting of the Kaministiquia Power Company, held in Montreal, the dividend was raised from a 5 to a 6 per cent. basis, the new rate of 1½ per cent. being payable quarterly. The company was authorized to issue $200,000 new stock at par.

A by-law will be submitted authorizing the raising, by debentures, of the sum of $90,000 to improve and extend the municipal telephone system.

The municipal department of Fort William and Port Arthur have made a temporary arrangement for the operation of a through service between the two cities just as in the past when the two systems were under one management. It is arranged that cars and crews will be run through but fare boxes will be changed at the boundary. It is provided that if, in the regular schedule time of operating this through service, cars should be detained longer in one city than in the other, that city in which cars are detained shall pay the extra operating cost. Each city is to have distinctive tickets. Wages of employees shall be the same in both cities. Power wires are to be cut at the boundary line, but switching arrangements are so made that either city can feed on to the other's line in case of an emergency.

A by-law is being submitted giving authority to raise $238,000 for improving and extending the railway system.

Forest, Ont.

The new municipal electric power and lighting plant was started up on December 23.

Guelph, Ont.

A by-law authorizing expenditure for street railway improvements and extensions carried. This will include the purchase of two new cars.

Goderich, Ont.

Niagara Falls power was turned on December 29 in Goderich, the power line being run out from Stratford through Seaforth. At the present time Goderich's equipment consists of three 250 kw. transformers, 26400/2300 volts.

Hull, Que.

The Hull Electric Company have just placed an order with the J. G. Brill Company covering four pairs of trailer trucks.

Hamilton, Ont.

The Otis Fensom Elevator Company have submitted an estimate on the cost of constructing an incline rail-

way at the head of Sherman Avenue. The estimate is in the neighborhood of $250,000.

A by-law authorizing the expenditure of $335,000 for electric extension work was carried.

Engineer E. I. Sifton has issued a report on the progress of the hydro-electric system during the year 1913, which shows that the number of customers has increased from 1,231 to 7,095 with a total connected load of 10,378 h.p., not including the Beach waterworks. In the course of his remarks, Mr. Sifton states that this business has been obtained on approximately a 4½ per cent. basis, the average cost per residence and commercial contract being about 36c each and the average cost of connected load in power being about 45c per h.p., these figures including the proper proportion of office expense in addition to solicitors' salaries.

Humboldt, Sask.

A by-law to expend $20,500 for electric light distribution extensions was recently carried.

Halifax, N.S.

The Woodside Sugar Refinery Company are installing a very unique electrical plant which is claimed to be the first sugar refinery plant in the world driven entirely by electrical power, the only steam driven machinery in the whole installation being two auxiliary pumps. An isolated plant is also being installed comprising three Westinghouse 937.5 kv.a. bleeder type turbo-generators. The complete electrical installation is in charge of John Starr, Son & Company, electrical engineers and contractors, Halifax, N.S.

Havelock, Ont.

The ratepayers recently voted a by-law authorizing the council to purchase power from the Hydro-electric Power Commission of Ontario.

Kingston, Ont.

The Kingston, Portsmouth & Cataraqui Railway Company have awarded a contract for the supply of steel rails to be used on King and Princess streets, to the United States Steel Products Company, delivery to be made by March 1

Kamloops, B.C.

The city of Kamloops have succeeded in disposing of their debentures at a rate satisfactory to the council and will proceed with the construction of their hydro-electric plant as soon as the weather will permit.

Lake Megantic, Que.

Tenders were received up to January 5 for the construction of a concrete dam in connection with the municipal hydro-electric plant. Mr. E. A. Evans is the engineer-in-charge. Tenders for machinery will be called a little later.

Larder Lake, Ont.

The D'Or Huronia Company are reported to be preparing plans to develop a water-power plant in the neighborhood of Larder Lake which will enable them to operate their mine and mill on a larger scale.

Laprairie, Que.

The town of Laprairie have installed eighty-five tungsten lamps for street lighting and will also supply current for house lighting purposes. The town is being supplied by the Montreal Light, Heat & Power Company.

London, Ont.

A by-law authorizing the operation of Sunday street cars was carried in London by a large majority.

The city is now supplying the London Street Railway System from a motor-generator set recently installed. As the railway company will eventually take in the neighborhood of 1,000 h.p., this is an added possibility of reduced rates in London.

Lake Beauport, Que.

A telephone system was recently inaugurated in this place connecting the parish with the city of Quebec.

Montreal, Que.

An application by the medical men of Montreal to the Railway Commissioners complaining of the discontinuance of reduced tolls by the Bell Telephone Company was dismissed. The doctors had been allowed a special rate of $10 per annum, against a rate of $55 for business telephones.

The Quebec Legislature have declined to ratify an agreement between the municipality of Pointe aux Trembles and the Montreal Tramways Company granting the latter a forty years' franchise.

The new year has opened in a somewhat disappointing way for Montreal electrical contractors, work being perhaps 25 per cent. below the normal. The dullness is, of course, more marked owing to the exceptionally brisk business in 1913, which resulted in many new firms starting.

With a view to giving the employees an interest in the company, the Montreal Light, Heat and Power Company have issued 1,000 shares at par—(the Stock Exchange price is now round about 215)—the amount payable being spread over three years in twelve equal quarterly instalments. In case of death the payments can be continued by the executors. At the end of three years the shares become the absolute property of the employees, who can dispose of them if so desired. The shares were subscribed three times over, allotment being made pro rata in accordance with the rate of salaries paid to employees of one year's standing. It is understood that this issue of stock will probably be followed by others.

During the past season the C. P. R. Telegraph department constructed about 6,000 miles of wire and new lines, the chief work being in the west. In the manitoba division there were 1,045 miles of copper wire, 90 miles of iron wire, and 151 miles of train despatching telephone circuit. In Saskatchewan 585 miles of copper wire, 617 miles of iron wire, and 25 miles new extensions. In Alberta, 1,065 miles copper wire, 713 miles iron wire, 50 miles railway equipped with train and telephoning despatching circuits, and 250 miles of line on new railway.

The Montreal Tramways Company have purchased from the Canadian Light and Power Company a large block of land in the parish of Lachine, for the construction of yards and car barns. The purchase price was $153,175.

Nelson, B.C.

The ratepayers passed a by-law to purchase the street railway system and operate it as a municipal enterprise.

North Burnaby, B.C.

The new street car line was officially opened for service on December 23. This is an extension of the Hastings Street East line to the foot of Capitol Hill and is stated to be but one of a number of lines that will eventually give Burnaby residents better transportation facilities.

Oshawa, Ont.

A by-law authorizing a contract with the Oshawa Electric Company for power for the waterworks plant carried.

Orillia, Ont.

The annual statement of the receipts and expenditures in the electrical department for 1913 shows that the town

of Orillia has made splendid progress during the past year. The total receipts are $55,477. After paying all expenses, including operation, maintenance, power costs, salaries, sinking fund and all reconstruction and extension work, amounting to $11,140 in the past year, there is still a net balance of $2,156.

Ottawa, Ont.

The Fire & Water Committee have recommended the installation of a new fire alarm system by the Northern Electric & Manufacturing Company.

The Ottawa Electric Railway Company will require heavy steel rails for some mile and a quarter of track on Sussex and Bank streets, when, or if, the paving work is undertaken by the city.

According to the custom followed in other years the Ottawa Electric Railway Company gave each of their 600 employees last Christmas a present of $2, the money being paid to the men on Christmas eve. Prior to about three time, but as this did not particularly suit the unmarried men years ago each employee received a turkey at Christmas it was decided to give money instead.

Peterborough, Ont.

The new magnetite arc lamps were lighted for the first time on Wednesday, December 17. There are 120 lamps in the installation.

The city council have withdrawn their resolution requiring the Otonabee Power Company to remove their poles from the city streets on January 1. This hasty action on the part of the council was evidently going to inconvenience the citizens greatly. The company throughout have taken a most reasonable attitude in the matter.

Penetanguishene, Ont.

The Hydro-electric Power Commission of Ontario will be asked to prepare an estimate on the cost of an electric line connecting this town with Midland and Port McNicol on the Canadian Pacific Railway.

Parkhill, Ont.

The matter of installing an electric distribution system will be taken up at once by the new council and Mayor Harrison.

Preston, Ont.

The by-law passed granting the Galt, Preston & Hespeler Railway Company a 25-year franchise.

Richmond Hill, Ont.

A by-law to expend $4,000 on municipal electric improvements was carried.

Regina, Sask.

The following rural telephone companies have been incorporated:—Rich Prairie Rural Telephone Company, Limited, Bienfait; Thorson Rural Telephone Company, Limited, Macoun; Elstow Rural Telephone Company, Limited, Elstow.

The following telephone companies have been incorporated:—Outram Rural Telephone Company, Outrom, Sask.; Silver Lake Rural Telephone Company, Bladworth Sask.; Wilberforce Lampman Rural Telephone Company, Lampman, Sask.; Roxboro Rural Telephone Company, Griffin, Sask.

The November operation revenue and expenditure returns for the Regina Municipal Railway system was as follows:—Revenue—Car earnings, $19,225.55; miscellaneous earnings, $1,537.95—$20,763.50. Expenditure—Maintenance of way and structures, $527.86; maintenance of rolling stock $513.87; purchased power, $5,626.52; conducting transportation, $11,593.73; general expenses, $1,315.71—$19,577.69. Balance revenue over expenditure, $1,185.81.

Operation returns for the week ending December 20, of the municipal street railway system of the city of Regina were as follows:—Revenue, $4,212.05; passengers carried, 102,085; passengers carried including transfers, 115,702. The corresponding figures for the week ending December 27 were $4,537.20; 105,864 and 117,399.

Saskatoon, Sask.

A regular service has been installed on the suburban line connecting Saskatoon with Sutherland a distance of approximately three miles. An hourly service is given from six o'clock in the morning till twelve midnight, cars leaving Saskatoon on the hour and Sutherland on the half hour. A five cent fare is charged between the city limits of Saskatoon and the Sutherland end of the line.

The negotiations between the city commissioners and the manufacturers of four new double truck cars have resulted in these being accepted by the city. They will be placed in operation at once.

Sackville, N.B.

The Eastern Development & Telephone Company which supply electric light to the town of Sackville and vicinity are increasing their rates by varying amounts in the neighborhood of 15 and 20 per cent. The matter is being considered by the Public Utilities Commission of New Brunswick.

Stratford, Ont.

Stratford's light rate in the future will be 4c per 100 sq. ft. plus 4c per kw.h., the latter being a reduction from 4½c. The rate for commercial lighting will be 8c per kw.h. for the first 30 hours of installed capacity or maximum demand and 4c per kw.h. in excess. The discount for prompt payment will be 20 per cent.

The total revenue of the Stratford Light & Heat Commission, estimating the last part of December is placed at $55,010, an increase of $11,638 over 1912. The estimated net profits for 1913 are $9,558 more than double the previous year's. During the past year the number of customers has grown by 318 bringing the present total to 1,556.

Strathroy, Ont.

A by-law authorizing the expenditure of $45,000 carried in Strathroy, the money to be expended on the installation of a distribution system for Niagara power. The initial rate to Strathroy will be $44.

St. John, N. B.

Mr. A. R. Gould, president of the St. John Valley Railway Company, has secured a charter for a railway across the northern part of the State of Maine, thereby connecting the present lines in Quebec and New Brunswick. The new line will be 111 miles long, and will be operated by electricity. Mr. Gould states that the power now developed along the proposed route is sufficient for the electrification of the line.

Stouffville, Ont.

A by-law submitted at the January election authorizing the purchase of the local electric light plant at a cost of $5,000 carried by a fair majority. An extra $2,000 will be expended in improvements.

Toronto, Ont.

The contract has been awarded by the Board of Control to the Canadian Allis-Chalmers for one 7½ and one 20 million gallon pump connected to C. G. E. motors.

A by-law authorizing the purchase of that portion of the Toronto & York Radial Railway System between Sunnyside and Humber River was carried.

Hydro-electric by-laws were carried in Hanover, Strathroy, Wallaceburg, Elora, Kemptville, Chesley and Tilbury by good majorities. An adverse vote was recorded in Sandwich.

The gross receipts of the Toronto Railway Company for the year 1913 were $6,056,005. Of this amount the city will receive, including track rentals, something over $1,000,000.

Taber, Alta.

A new electric street lighting system has been installed and placed in operation here. The power supply is obtained from the Canada West Coal Company.

Truro, N.S.

The municipal street lighting system consisting of tungsten clusters on the main street and single units on the side streets was recently placed in operation.

Uxbridge, Ont.

The application of the Home Telephone Company with branches in Whitby, Port Perry, Uxbridge and intermediate points to compel Uxbridge & Scott Telephone Company to give the Home Company direct connection between certain points instead of by a circuitous route has been granted by the Ontario Railway & Municipal Board. The order will not be enforced for some weeks as negotiations are at present under way for the purchase of the Uxbridge & Scott Company by the Bell Telephone Company.

Victoria, B.C.

City electrician Hutchison is at present busy installing a quantity of sub-station equipment for the extension of the city's street lighting arc system.

Vancouver, B. C.

The annual report of the B. C. Electric Railway Company to June, 1913, reflects to some extent the trade conditions in that province. The gross earnings increased $1,035,869, or about 17 per cent., but practically the whole amount was absorbed by higher working expenses, due in part to the coal strike. These expensive working conditions are said to still continue and may affect the current year's earnings. The directors hope, however, to maintain the present rate of dividend by the recently announced increase in the fares and by reducing expenses wherever possible. The total money expended up to June 30, 1913, by the company, amounts to $45,168,312. The amount paid out in interest and dividends for the year totalled $1,888,139, equal to 4.18 per cent. on the entire investment. In the past financial year the number of passengers carried was 71,973,822, an increase of 1,819,656. In the first year of operation, 1906, 12,395,582 passengers were carried.

Vernon, B.C.

The Vernon Board of Trade has petitioned the provincial government for assistance in laying a telephone cable in Lake Okanagan to serve the district on the west side of the lake. The petition states that there would not be sufficient subscribers to justify the local company in making the outlay itself but that the company would undertake to buy back the cable as soon as that part of the system becomes self-sustaining.

Wilkie, Sask.

A by-law will be submitted in the near future regarding extensions to the electric light system.

Waterloo, Ont.

The light and power rates which went into force on January 1 in Waterloo are as follows: domestic lighting, 4c per 100 sq. ft., plus 4c per kw.h with 25 per cent. discount; commercial lighting, 8c per kw.h. for the first 30 hours use of installed capacity or maximum demand and 4c per kw.h. for all added consumption, with 25 per cent. discount; power, a service charge of $1.00 per month with consumption charges of 2.5c, 1.7c, and 0.2c, with 10 per cent. discount. The rate for street lighting is $9.00 per lamp per year.

Winnipeg, Man.

Tenders are called to January 29 for switching gear and accessories for the King Street sub-station.

A disastrous fire on December 20th caused heavy damage to the stock of the Shipway Electric Company, manufacturers agents, Winnipeg.

Tenders are received by the Board of Control until January 22nd for a slip gate, slip gate lifting mechanism and other auxiliary apparatus in connection with the additions to the Winnipeg municipal electric plant.

Welland, Ont.

A by-law was submitted in the township of Crowland on January 5 to give authority to the Welland Electric Company, Limited, to erect a transmission line through the township.

Winnipeg, Man.

The new street lights along Portage Avenue and Road from the west city limits to Headingly were recently placed in operation. There are 61 arc lights in this installation installed on 30 ft. poles.

Acting on the report of the manager of the City Light & Power Department the Board of Control have recommended that the contract for meters for 1914 be awarded as follows, being the lowest satisfactory tender in each case, namely:—Packard—single-phase, 2-wire meters; Ferranti—single-phase, 2-wire meters, polyphase meters; Canadian General Electric—single-phase, 3-wire meters; W. E. Skinner, Limited—direct current meters.

Yarmouth, N.S.

A committee appointed to consider the question has recommended that a fire alarm system to cost in the neighborhood of $4,000 be installed in Yarmouth by the Northern Electric & Manufacturing Company.

View showing the big hydraulic fill dam at Lake Coquitlam, nearing completion. See descriptive article on page 39 of this issue.

A Miniature Electric Night Lamp

By Mr. T. H. Dempster*

With the advent of electric light the need for a small low candle-power lamp has been felt. Up to the present time this has not been successfully met. To fill the need of a small electric light, which could be applied to the ordinary distribution voltage and yet be of sufficiently low watt consumption to create a wide-spread use as a night light, a combination transformer and drawn-wire tungsten lamp has been developed.

It is well known that hospitals and sick rooms demand a lamp of low candle-power in order that the nurse or attendant may seek assurance as to the patient's comfort in the matter of bedclothes, ventilation, or temperature of the room, all without the disturbance incident to the operation of switches and the glare of high power lamps. There is a wide field for such a miniature lamp, however, that has been previously handicapped by the much greater total current consumption of the previously lowest candle-power lamp that has been available to be burned directly on the service voltage.

In a residence, such as the average flat or cottage, a night lamp burning in the hall, bathroom, sitting room, or at the cellar stairs during the evening or all night is a convenience to be tried to realize its value fully.

In the matter of cost of operation, a small lamp such as has been heretofore available, taking about 20 watts, would, if used as a night lamp burning 10 hours per day for 30 days, cost in the neighborhood of 50 to 60 cents per month, figured according to the prevailing rate for energy. This is a prohibitive figure for the ordinary householder, and would not tend to make universal the use of electric service during the night.

However, the device herein described will, at a cost of only a few cents per month, sufficiently light the rooms in an ordinary house throughout the night to permit a person safely passing to and fro. As an example of an average house, the installation would probably be as follows: one lamp located at each of the following places; the name and number-plate on front door, front hall, bathroom, one bedroom, and cellar or rear stairs, making in all five lamps. The energy required for the five transformers and lamps would be about 6 watts, and for 30 days at 4 hours per night would cost about 7 cents. For a 10-hour night service the cost would only amount to about 18 cents per month. Such a low cost of operation for light in so many places warrants the all night use and makes a pleasure of what would otherwise be a burdensome luxury.

The complete device consists of a miniature transformer contained within a brass shell and adapted to screwing into the standard lamp socket in place of the usual incandescent lamp. The shell carries at the other end a candelabra socket to take miniature plain or frosted lamps which are ordinarily rated at about one candle-power.

The miniature transformer is wound to operate on 60-cycle alternating current circuits of 100 to 125 volts. It is well insulated, of course, and has a shell-type laminated iron core working at moderate magnetic density. The windings operate at an ordinary current density, are separately insulated, and have a ratio of 10 to 1. The temperature rise of the transformer in operation is barely perceptible, being usually only about one or two degrees, which proves the high economy of the device. At no load the average energy taken by the transformer is about 1/5 of a watt; and when loaded with a lamp giving about one candle-power, the input is about 1¼ watts.

The device fills a long felt want for a very small light unit which can be operated alone or in groups without having to recourse to wasteful dead resistances or several lamps in series to consume the average 110 volts of the lighting circuit.

*Research Laboratory, General Electric Company.

Lighting Schedule for February, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Feb. 1	10 20	Feb. 2	6 30	8 10
2	11 20	3	6 30	7 10
4	0 30	4	6 30	6 00
5	1 30	5	6 20	4 50
6	2 30	6	6 20	3 50
7	3 30	7	6 20	2 50
8	4 20	8	6 20	2 00
9	No Light	9	No Light	
10	No Light	10	No Light	
11	6 00	11	8 20	2 20
12	6 00	12	9 40	3 40
13	6 00	13	11 00	5 00
14	6 00	15	0 10	6 10
15	6 00	16	1 30	7 30
16	6 00	17	2 50	8 50
17	6 10	18	4 00	9 50
18	6 10	19	5 00	10 50
19	6 10	20	6 10	12 00
20	6 10	21	6 00	11 50
21	6 10	22	6 00	11 50
22	6 10	23	6 00	11 50
23	6 10	24	6 00	11 50
24	6 10	25	6 00	11 50
25	6 20	26	5 50	11 30
26	6 20	27	5 50	11 30
27	6 20	28	5 50	11 30
28	6 20	Mar. 1	5 50	11 30

Total Hours............206 10

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

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Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

WANTED

Alternators—60 cycle, 3 phase, 2,400 or 600 volts, preferably latter. One about 150 k. w., other about 300 k.w., belted, with exciters and generator panels. Also 2 vertical turbines, sixty inches to seventy inches. Send full particulars. Box 935, Electrical News, Toronto. 2

Wanted Employees

WANTED—Experienced man to take charge of meter testing in sub-stations and central stations. Salary $90 per month to start. Good chance for advancement.

Northern Ontario Light & Power Company,
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We use Prime Western Spelter and we Galvanize to Western Union standard specification.

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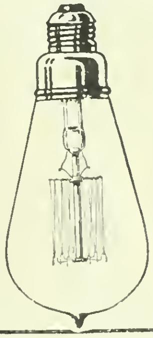

Shuman-Wire Drawn Tungsten Lamps

DO YOU SELL THEM?

Think what it would mean if you could say "Here Mr. Man is a written guarantee for this tungsten lamp". Stock Shuman-Wire Drawn Tungsten Lamps and you will sell a guaranteed article.

Guarantee—"We agree to replace lamps, not including transportation charges, if they do not prove satisfactory."

SHUMAN ELECTRIC COMPANY,
ELECTRIC SPECIALTIES

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St. Catherine St. West
Up 7446
MONTREAL

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for your streets, factory, warehouse or yard

A. H. WINTER JOYNER, Ltd.
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A few dollars spent in advertising your proposals in

The Contract Record

would result in additional competition, which might save your city or town or your client many hundreds of dollars.

Electrical News

Generation, Transmission and Application of Electricity

Published Semi-Monthly By

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Vol. 23 Toronto, February 1, 1914 No. 3

Knowledge of First Aid Methods

A recent letter by Mr. Chas. F. Gray, published in these pages regarding the large number of deaths from electric shock and the best means of precaution has been the means of arousing interest in certain quarters, but there seems to be a considerable apathy concerning this matter on the part, often, of those who are most vitally concerned.

Mr. Gray's suggestion of the formation of a committee composed of good first aid men is valuable; all the more that the very formation of such a committee would arouse general local interest in the subject. Of equal importance it seems to us, however, is it that a thorough knowledge of first aid methods should be a necessary and legally required qualification of every man who is engaged in any phase of practical electrical work.

Statistics apparently are not available as to the relative number of accidents, by electric shock, of electrical and non-electrical workers, but it is probably safe to say that (say) 90 per cent. of the total accidents happen where they might naturally be expected to happen, i.e., where some electric installation work or supervision is under way. As two or more men are almost invariably employed in this work it will be evident that a knowledge of first aid methods by the companions of the victim is an all-important consideration. We repeat again, therefore, that considering the simplicity of the different methods of resuscitation, the tremendous importance of immediate action and the likelihood of accident among electric workers it seems almost a case of criminal neglect that first aid knowledge has not been made a necessary legal qualification of every electrical workman.

Of the many methods of resuscitation it is doubtless a difficult matter to say which is the most efficient, and indeed the very nature of the subject renders it quite impossible that this should ever be determined. All the different methods are valuable and apparently efficient if promptly, properly and persistently carried on. The prime consideration is, without doubt, that some method or other should be used promptly. Of the manual methods it can perhaps be objected that, while very efficient, they depend too much upon the technical knowledge, good judgment and persistence of the attendants; of the automatic, that cost may be a consideration, that they need more or less regular inspection and that the more machinery the more danger of delays. Doubtless each municipality or company must consider all the different methods and adopt the one most suited to local conditions. On another page of this issue we publish a brief review of the more common methods of resuscitation now used and including an instrument recently introduced to the Canadian market which appears to have much to reccommend it.

Canadian Electric Railways

In this issue we print a brief review of the electric railway situation in Canada. The past year has been one of average activity in spite of the adverse financial conditions, and although it is a little early to predict the amount of development that is likely to be carried through in 1914 there is good evidence that this will greatly exceed that of any previous year. Especially noticeable is the imminent development in interurban railway construction. The rural communities are clamouring for transportation as they have done for telephones and mail delivery and other urban advantages. There are many indications which point to a large amount of interurban construction during the coming summer.

Improvements in Turbine Design

As Canada is destined in the early future to be recognized as one of the greatest water-power countries in the world it is of considerable interest to note the decided progress made during the past two or three years in the efficiency of water turbines. A few years ago the average efficiency of a water turbine was in the neighborhood of 80 per cent. and guarantees by the manufacturer of anything higher than this were looked upon with distrust. The change which has taken place is shown by the fact that no guarantees less than about 87 per cent. are now offered, and in one specific instance at least, an efficiency up to 93.7 per cent. has been obtained.

The question of turbine efficiency and design is covered very fully in a paper recently presented by Mr. H. B. Taylor, before the mechanical section of the Can. Soc. of Civil Engineers, at Montreal, on January 15. Mr. Taylor states that the improvements are very largely traceable to the co-operation in recent years between hydraulic engineers associated with operating companies and the manufacturers of water turbines, this co-operation being all the more valuable on account of the practical experience of operating engineers—an experience which the manufacturer is necessarily unable to obtain. There is also a decided change in the attitude of the average purchaser of water turbines, who now appreciates the value of efficiency in his prime mover. Mr. Taylor calculates that the turbines in any hydro-electric installation only cost from 2½ per cent. to 10 per cent. of the total installation and when it is considered that the efficiency given at this point will be carried through every stage of the development it can easily be seen how necessary it is to exercise the greatest care in the choice of this fundamental. To quote Mr. Taylor on this point—"When it is considered that the success of the total development is absolutely dependent upon the power performance of the turbines, and the earning power on the total investment may be in proportion to the efficiency of the tur-

lines the folly of chancing the installation of inferior apparatus is self-evident."

According to this article improvements have been shown in the general development of turbines as well as in all the auxiliaries of turbine casing, guide vanes, space between the guide vanes and runner, various sections of the draught tube, as well as in the design of gates, penstocks, etc. A noticeable change has come about in the introduction of the single runner unit as compared with the multi-runner type for low heads. Two striking examples of this are the recently completed installation of the Mississippi River Power Company with a head of 32 ft., and the installation of the Cedars Rapids Manufacturing and Power Company of Montreal, where a 30 ft. head plant is under construction. The generators in connection with both of these plants have a speed of about 56 r.p.m. and diameters of 32 and 36 ft. A noticeable improvement in general design is also shown in the absence of corrosion in the later types of turbine, which, it has been conclusively shown, was due to imperfect design. This chemical action was a troublesome factor in the earlier types of turbine before the cause was properly understood. It is stated that since improved design has eliminated the danger of corrosion it is now feasible to manufacture turbines of cast iron where recently it was considered necessary to use a special kind of bronze, the theory being that the iron was more susceptible to chemical action than the bronze. On other pages of this issue Mr. Taylor's paper is reproduced in full.

The Critical Public

At the recent annual meeting of the British Columbia Electric Railway Company considerable apprehension was shown by many of the shareholders at the small profits earned on capital by this company, which during the past year is only approximately 4½ per cent., including all the operations of the company, railway, light and power. It is very doubtful if the citizens of Vancouver and the surrounding neighborhood sufficiently appreciate the important part the B. C. E. R. has played in the tremendous developments that have taken place during the past few years in that district. While companies in many other cities on this continent have, by comparison, been starving their plant and hesitating to make extensions and expenditures the B. C. E. R. Co. have been almost lavish in their developments, apparently having at heart the interests of the section of British Columbia they serve rather than the particular and immediate interests of their shareholders. We know of no place on the American continent where this spirit has been more in evidence.

It is only human, of course, that there should be a certain amount of expressed dissatisfaction at the service given by the B. C. E. R. Co., but it simply goes to show that you cannot please all the people all the time no matter what sort of a service you give and no matter how much capital expenditure you may make for their comfort and convenience. The prominence of Vancouver, Victoria and the surrounding district to-day and the rapid increase in wealth of this section during the past few years is in a very great measure, indeed, traceable to the extensive development policy of this great company.

Special Trains to International Congress

Plans are already well under way for one or more special trains from the East to San Francisco in connection with the International Electrical Congress to be held in that city in September, 1915. The trains themselves will represent the last word in safety and comfort, while their itineraries will be laid out to include the finest scenery in the country.

The tentative programme, which at a later date will be submitted in detail to engineers of the United States and other countries for an expression of their individual preferences, includes a round trip of about 30 days' duration with stops in Chicago, Colorado Springs, Salt Lake City, San Francisco, Santa Barbara and Los Angeles. At each one of these places, special arrangements will be made by local committees for the comfort and entertainment of the members of the party. Other features of the trip will be the Royal Gorge, the Feather River Canyon, and a four-day visit to the Yellowstone National Park on the way out, with a 24-hour stop at the Grand Canyon on the way home. Should the demand justify it, a special train will also be provided from Chicago straight through to San Francisco to take care of those with whom time is a prime consideration. The transportation committee of the congress is further considering the possibilities of marine transportation by way of the Panama Canal. There appears to be a considerable demand for this, especially if satisfactory arrangements can be made for combining the land and water features.

Portable Wireless in Forestry Work

At a recent convention of the Western Forestry & Conservation Association held in Vancouver, B.C., Mr. J. R. Irwin, of one of the Marconi companies, gave an interesting address on the value of wireless equipment in the preservation of forests. Mr. Irwin explained that a portable wireless equipment not too heavy to be carried by one mule had been devised by his company and that this equipment had a range of from 15 to 25 miles. The following remarks referring to this equipment are interesting:—

"We are in a position to supply you with portable outfits which can be carried upon muleback and are built for strength and efficiency, and I shall first roughly describe which I consider the best unit for your work. It is estimated that the average mule pack is 90 pounds on each side of the saddle. We first adapt a saddle for our peculiar uses, utilizing it after it has been off-saddled as a stand or instrument table. Upon one side of the saddle we carry a small gasoline engine somewhat similar but lighter than a motorcycle engine. This is directly connected to a small alternating current generator which supplies us with the electrical power necessary to operate the wireless equipment. This piece of apparatus is the heavy part of the outfit and would occupy one side of the load. Upon the other side is a half kilowatt transformer, or as the case may be smaller, as the use for which it is required is considered. The half kilowatt transformer is the heaviest piece of the actual wireless set, and weighs approximately 25 pounds. On the same side of the saddle are located the condenser, helix, operating key and other small parts weighing but a pound or two. Here we also have the receiving outfit, which also weighs a trifle and could be carried in the pocket. On top of the saddle is the spool upon which is wound the antenna wire used for the aerial; this is of light flexible aluminum wire and is not weighty. A portion of it is also used as ground connections. Fuel is carried in tubes or tanks conveniently fitted on the saddle—also light bamboo rods fitted like a fishing-pole for a mast where high trees are not available. It is an idea of my own which I have not yet been able to prove if practicable, that gasoline could be carried in these mast tubes, thereby saving weight and space. This entire outfit can be off-saddled and quickly adjusted as it is practically set up upon the saddle.

The average distances over which you will require to communicate are from 15 to 25 miles. The set I have described would easily accomplish this and greater distances according to the conditions, which, of course, vary, but given the worst which we should figure upon, these distances would be a simple matter.

It has been pointed out to me that our system requires

skilled operators. This is true to a certain extent but I would advise you that fully fifty per cent. of our operating staff is made up from men from the villages and small towns of the interior, men familiar with forests and country life, young fellows able to jump in and turn their hand to anything. These men are for the most part of good physique, a very large number being discharged from the army and navy after honorable service, with an excellent training and thoroughly subservient to discipline. I feel sure that men of this class could be adapted to your service."

Their Silver Anniversary

On December 27, 1913, the directors of the Canadian General Electric Company met to commemorate the twenty-fifth anniversary of the organization of a syndicate to inquire into the feasibility of establishing a system of incandescent lighting in Toronto, which syndicate subsequently organized the Canadian General Electric Company. At this meeting the history of the past twenty-five years was covered in a most thorough manner in an address given by Mr. Frederic Nicholls, the president and general manager of the company, in which he outlined the growth of the company's business as represented by an increase in assets at the rate of $1,000,000 a year for the full twenty-five years, by the amalgamation of some 16 companies of allied interests, and by the opening from time to time during that period of some 16 branches in addition to the large central head office in Toronto. The following extracts from Mr. Nicholls' address are of general interest to the electrical fraternity. They represent in a remarkable degree the possibilities of growth, past and future, in this Canada of ours, given only good management and confidence.

"On the 27th of December, 1888, I called together a number of gentlemen then, as now, prominent citizens of Toronto, with a reputation as successful and public spirited business men. They then affixed their signatures to a simple letter of agreement to join me in a syndicate to provide a fund to defray the expenses of inquiring into the feasibility of establishing in Toronto an electric plant to supply electric light and power by means of underground wires, and at that time I little thought of the tremendous development that lay before us.

The first company to be organized by the syndicate was the Toronto Incandescent Electric Light Company, on the 26th day of June, 1889, the intervening time since the organization of the syndicate having been occupied in negotiating an agreement with the Edison Electric Light Company, of New York, for the exclusive use of their system, and, by prolonged negotiations with the City of Toronto, for a franchise to generate electric light and power, and distribute the same by underground conductors. This company was very successful, and was subsequently amalgamated with the Toronto Electric Light Company.

Our next company was the Toronto Construction and Electrical Supply Company, which was incorporated on the 11th of February, 1891. This company was the parent company of the Canadian General Electric Company.

The business of the Toronto Construction and Electrical Supply Company was the sale of electrical apparatus and supplies, and soon after its incorporation, on the 14th of October, 1891, it formed an alliance with the Thomson Houston Electric Company of Boston, and entered into an agreement to act as their sole agents for Canada. From the start this company was very successful, and secured in a short time such favorable recognition from the purchasing public that negotiations were entered into for the purchase of all the Canadian property and interests of the Edison Electric Light Company, including their factory at Peterborough, the Thomson-Houston and Edison interests in the United States having in the meantime been merged into the General Electric Company. After some delay in the negotiations, an agreement of purchase was concluded, and the Canadian General Electric Company was organized on the 5th of September, 1892, so that the Canadian General Electric Company, which was the outcome of the original investment of $10,000 by the syndicate of ten, has some time since attained its majority.

At the time we purchased the Canadian property of the General Electric Company, we also acquired the exclusive rights of the Edison Co., the Thomson-Houston Co., the Fort Wayne Electric Co., and the Brush Electric Co., and since then have from time to time acquired the Canadian business and good-will of many other companies that have enabled us to extend our field of operation, including amongst others: The Ball Electric Light Co., 1892; the Peterborough Carbon Co., 1895; the Electric Storage Battery Co., 1898; the Canada Foundry Co., 1900; the Royal Electric Co., 1900; the Stanley Electric Co., 1900; the Northey Steam Pump Co., 1902; the Sunbeam Electric Lamp Co., 1912; the Tungstolier Company, 1912; the Canadian Holophane Co., 1912; the Allis-Chalmers Mfg. Co., 1913; the Stratford Mill Building Co., 1913.

In May, 1901, the company purchased a valuable water power development, four miles from the Peterborough works, where our electric power for operating has since been generated, and in 1910 we secured a twenty-year leasehold from the town of Peterborough of a part of their waterworks dam, where we have developed an additional 1,000 horse power.

I do not desire to pose as a prophet, for the reason that our own future must run parallel to the future development of our country. Personally, I have the utmost faith in the future development and continued prosperity of Canada. Occasional set-backs we must expect, but the march of progress must be always onward, as so much of our great country still remains to be developed and populated. Next year, two new transcontinental railways, the Canadian Northern and the Grand Trunk Pacific, will be in operation for the first time, operating through trains from the Atlantic to the Pacific. The Canadian Pacific Railway have increased their trackage, rolling stock, and other facilities, at an expenditure equal to that required to build a new railway from ocean to ocean The contracts for the new Welland Ship Canal have been let by the Dominion Government. Public works of great magnitude are either under construction or being projected by the Federal and Provincial Governments. Up to the present our immigration has continued to increase, so that, taking it all in all, the future is full of promise even though for some short while we may experience a recession in trade, as a result of the present world-wide financial uncertainty.

Mr. F. A. Vanderlip, President of the National City Bank of New York, an authority on financial and trade statistics, in a recent address, made the statement that the intelligent development of the electrical industry in the Uniter States will readily absorb for the next five years, $400,000,000 a year, or $8,000,000 a week. I do not predict that in Canada our percentage of trade, on a pro rata population basis, will be so startling, but there is no reason why we should not expect a satisfactory growth in the demand for our products.

A normal growth of population may be counted on. The trunk line railways will undoubtedly electrify certain sections, such as terminals and mountainous divisions, and I am pleased to say that the first two important contracts that have been let for the electrification of steam railways in Canada have been awarded to this company. I refer to the electrification of the Rossland-Castlegar division of the Canadian Pacific Railway in the Rocky Mountains, and the elec

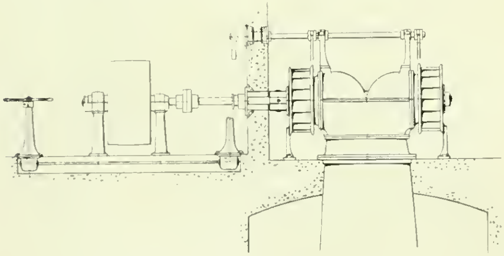
trification of the tunnel under Mount Royal, and the Montreal Terminal, for the Canadian Northern Railway.

In considering the future uses of electricity in Canada, we must have in mind the impetus this industry has received as a result of the utilization of our magnificent water powers. Few realize that from Quebec in the east, to Victoria, B. C., in the west, nearly every city, town and village has the advantage of hydro-electric power for its lighting, its street railways, and its industries. Quebec, Montreal, Ottawa, Toronto, London, Port Arthur, Fort William, Winnipeg, Calgary, Vancouver, Victoria, and intermediate points, are all operating hydro-electrically, and our reserves of water powers undeveloped will serve the needs of the country beyond our time."

The eight men who first conceived the idea of the formation of the syndicate which was the nucleus of the present great Canadian General Electric Company were Messrs. Frederic Nicholls, W. R. Brock, W. D. Matthews, J. K. Kerr, Geo. A. Cox, Robt. Jaffray, Hugh Ryan, and H. P. Dwight, and Mr. Nicholls referred with some feeling to the unique record of six out of the eight original directors who are still acting in that capacity after an unbroken period of a quarter of a century.

Chapleau Electric Light & Power Company

The Chapleau Electric Light & Power Company, have just increased their capacity from 200 h.p. to 400 h.p. to meet the growing demands of their vicinity for electric power. The draft tube and draft chest of the old turbines were not disturbed, but simply new "Francis" runners and "Fink" gate-cases of specially powerful design were attached and give the desired increase in power. The shafting, coupling, gate regulating mechanism, collar oiling thrust bearing, lignumvitae



Plan of hydraulic end of Chapleau plant.

bearings and generator drive are all new, very heavy and up-to-date. The diagram herewith indicates the layout of the hydraulic end of the Chapleau plant; the generator is belt driven.

The new turbines and machinery were built and installed by The Wm. Kennedy & Sons, Limited, of Owen Sound, Ont. The generator was supplied by the Canadian General Electric Company. The consulting engineer, for the power company, was Mr. J. B. McRae of Ottawa.

A Correction

In the article on page 60 of the January 15th issue of the Electrical News describing the 1000 kv.a. oil cooled transformers recently installed by the Winnipeg Electric Railway Company, the high tension voltage was erroneously given as 5,500. The correct voltage is 55,000.

McGill Science Men Hold Reunion

ON the evening of Saturday, January 17, the Ontario graduates of the Faculty of Applied Science of McGill University, Montreal, held a reunion at the Engineers' Club of Toronto. The meeting was a particularly happy and successful function and was attended by over fifty. The guests of the evening were: Dr. Adams, Dean of the Faculty of Applied Science of McGill University; Dr. Galbraith, Dean of the same faculty at the University of Toronto, and Professors C. H. McLeod and N. N. Evans, of McGill University.

After a pleasing menu had been disposed of and the toast to the King had been duly honored, the chairman, Mr. Willis Chipman, in a happy speech welcomed the graduates and introduced the toast-master, Professor Evans, who discharged the duties of this office most capably. The toast list was as follows:

"Our Alma Mater," proposed by Mr. W. F. Ferrier, B.Sc., and responded to by Dr. F. D. Adams.

"Applied Science," proposed by Mr. J. G. G. Kerry, M.Sc., and responded to by Professor C. H. McLeod.

"Sister Universities," proposed by Major T. Harry Jones, and responded to by Dr. Galbraith.

In proposing "Our Alma Mater," Mr. Ferrier, in an enthusiastic speech, directed the attention of those present to the prominent positions held by graduates of McGill University and showed how their achievements had brought honor to their alma mater. Replying, Dr. Adams reviewed the history of the Engineering Faculty from the time of its formation, showing how it had grown from a small class back in the 60's to a world-renowned institution with the present large attendance of 580. In the early days there were few buildings and less facilities, but now the advantages offered by the Faculty placed McGill in the forefront of engineering schools. Curves had been prepared showing the attendance from 1880 and the rapid increase as shown graphically was very marked. An idea of the cosmopolitan nature of the student body might be gathered from the fact that forty different nations were represented at McGill. The graduates were distributed over the greater part of the inhabited sections of the world and everywhere the name of the University was being upheld by men who were forging ahead in their profession.

An important announcement made by Dr. Adams was that Sir Wm. MacDonald had donated a site of some twenty-seven acres for the erection of new buildings for the University, these to comprise residences, gymnasium and edifices for the various faculties.

Mr. J. G. G. Kerry, in proposing "Applied Science," dealt with the men who were graduates of this faculty, making interesting reference to the achievements of those who stood out most prominently. Professor McLeod's response was along much the same lines as Mr. Kerry's observations and was particularly well received, practically all of those present having sat under Professor McLeod at college.

In proposing the toast, "Sister Universities," Major Jones commented upon the good spirit which existed between the several colleges and expressed gratification in knowing that instead of a feeling of jealousy there was one of friendly rivalry—a feeling which tended to give the students a most efficient and successful training. Dr. Galbraith, who replied, spoke at some length on the proper education of the engineer. A great many people entertained the idea that an engineer should be a master of mathematics and the sciences—a theoretical expert, but this was an erroneous principle. The student should be grounded in the first principles of the sciences and shown how to apply them. In this way the future engineer would be able to grasp what was required for the solution of any particular problem and would know where to seek and how to apply the necessary knowledge and theory. The

main theme of Dr. Galbraith's address was a common-sense, practical education for the engineer.

The toast list completed, Mr. Chipman called upon the assembly to honor the oldest engineering graduate present. Mr. Maurice Gaviller, who responded, giving some interesting reminisences of his experiences at McGill University in 1861-3. Mr. J. McEvoy then proposed the health of the toastmaster, Professor Evans, who replied with characteristic heartiness. Professor Evans' remarks were of particular interest in that they touched upon the work accomplished in connection with the Graduates' Society, an organization designed to keep track of the graduates and maintain a man's university connection by means of bulletins. It may be noted that the onus of the heavy duties involved in this work is borne by Professor Evans, who is honorary secretary. After the thanks of those present had been tendered to the committee in charge of arrangements by Mr. A. R. Davis, and acknowledged by Mr. J. R. Larmonth, a very pleasant evening came to an end. Mr. Willis Chipman came in for considerable congratulation as the proposer of the reunion and as one who had been particularly active in bringing the idea to a successful consummation.

The personnel of the committee was as follows: Mr. Willis Chipman, chairman; Messrs. W. F. Ferrier, J. McEvoy, A. L. Mudge, J. H. Larmonth, E. R. Clarke, H. G. Nicholls and M. J. McHenry (secretary).

Resuscitation From Apparent Death by Electric Shock

When attempting resuscitation from apparent death by electric shock the experience of every person who has been engaged in this particular work points to the necessity of the immediate application of some process or other. The first few moments are of the most vital importance.

The methods that may be adopted are in general very similar to those which are recommended for drowning. It is very important that the lungs should be cleared as completely as possible of all obstructions; also the passage leading to the lungs. The tongue should be well drawn out, sharply, so as to clear a path to the lungs.

Of the methods that have been advocated these may be said to divide themselves roughly into two classes—the manual or mechanic and the automatic. Of the former or mechanical process the two which have received most prominence are the Sylvester Howard and the Schafer methods. Both of these are excellent if immediately applied, though they depend, of course, upon the human element and require a certain skill, that is only attained by frequent practice in these methods.

The Sylvester Howard method consists of laying the patient on his back, and proceeding with the well-known resuscitation methods as applied in cases of drowning. The arms are extended above the head, and then returned to the side of the body in a bent position,—that is to say, with the elbows touching the floor—whilst the hands are brought back as near the shoulders as is possible. At the same time, when the arms are being brought back from the extended position to the side of the body, pressure is applied to the chest. This allows a very definite intake and exhaust of the lungs, the muscular effort, etc., all assisting towards resuscitation. The method, however, necessitates two men fairly well skilled in the operation.

Fig. 1—Schafer method of resuscitation.

The Schafer method is somewhat simpler though possibly as effective. The patient in this case is laid upon his stomach and pressure applied to the small of the back as shown in Fig. 1. The attendant then swings forward and backward slowly depressing and releasing in unison approximately with his own breathing. This can be carried out by one person though the operation is tiresome and there is danger that the work will be discontinued too soon.

In both the above methods, the human element enters into the success of the operation very considerably, and the movements should not be carried out in a hasty manner, particularly in the Howard process, in which one man must follow the other quite closely. The rate of the movements should be approximately the same as the time of one's own breathing. It is also necessary in this method as in all others, to see that the tongue is clear of the throat, and also that all the passages of the throat are free from any matter, blood, etc. Any scheme can be adopted to lift the tongue out, as with a handkerchief, and tying the same when using the

Figs. 2 and 3—Showing simple automatic equipment adapted to mechanical methods of resuscitation.

Howard process, but in the Schafer process the tongue will naturally fall forward.

Of the automatic equipments for resuscitation an instrument called the Pulmotor is probably the best known in Canada. This is a simple apparatus designed for performing automatic artificial respiration. When applied to the person to be resuscitated the lungs are first filled with air until normal pressure (eight inches water pressure) is reached when deflation immediately commences. These operations are continued automatically as long as required. A natural respiration is thus imitated as nearly as possible and is maintained regularly throughout. The pulmotor is, further, supplied with an oxygen reservoir and a certain amount of oxygen is mixed with the air as it is introduced into the lungs. It will be seen that this instrument when once at work, properly installed, should be very efficient. Its machinery, however, is somewhat complicated and delicate. It has also the objection which must hold for all automatic equipment that it takes a certain length of time to get it on the spot and to apply it. As an auxiliary to one or other of the mechanical methods there can be no question as to its great usefulness.

A simpler and apparently equally effective apparatus has very recently been placed on the Canadian market by Chapman & Walker, Limited, called the "synchron." The method adopted in this case is perhaps best described as an automatic mechanical method in that the apparatus can be readily adapted to either the Howard or the Schafer processes as described above. The patient is placed in the apparatus, his arms being carried upon a frame which is rocked, and this rocking motion not only moves the arms from a position extended above the head to a position extended in front but also compresses the abdomen at the right moment thus producing a very definite intake and exhaust of the lungs. The illustrations given in Figs. 2 and 3 show the simplicity of the apparatus and its easy operation. The machine is easily adjustable to any size of person.

The "synchron" has a rigid construction and there seems to be little possibility of its getting out of order. It consists chiefly of an oak base arranged for supporting the shoulders and head. Around the body an iron girth band is placed for compressing the abdomen or the back according to the particular process of manual resuscitation being adopted. The arms are carried in a frame moving through 90 deg. All the operator has to do is regulate the frame in unison with his own breathing and a perfectly synchronous cooperation between the movement of the arms and the movement of the chest is obtained with practically no fatigue to the operator, who is thus enabled to continue the operation for hours if necessary. It is on account of this absolute synchronism in the movements obtained that the instrument has been named the synchron.

It will be seen that this instrument endeavors to combine the advantages of the mechanical and automatic methods. It is cheap and can be made that much more easily available. It is quickly installed on account of its simplicity. For the same reason it is not likely to get out of repair during its use or to be out of repair when required suddenly. One operator is sufficient to manage it and the operation is not sufficiently vigorous to tire him to such an extent that he would be inclined to discontinue the work of resuscitation.

Developments in Hydraulic Turbines

Present Practice In Design and Construction—Marked Advance In Efficiency —A Matter of Prime Importance In Canada

By Mr. H. Birchard Taylor,* M. Am. Soc. M. E.

During the past ten years, hydraulic turbine design has passed through a stage of wonderful development and, in respect to many features, remarkable progress has been made toward bringing the turbine to a high state of perfection:

1st. As a result of theoretical investigation, substantiated by experimental research of the highest order, efficiencies have been increased on the average about ten per cent.

2nd. Corrosion of runner vanes, at one time a serious factor as affecting the maintenance of turbines and their efficiencies, has been eliminated subsequent to conclusive demonstration that it is primarily the result of defective design.

3rd. The development of high specific speed runners, thereby permitting the use of higher rotational speeds, has resulted in the rapid passing away during the past few years of the multi-runner types of turbines in favor of the vertical shaft, single runner type.

4th. At one time it was generally thought that the character of speed regulation of a turbine was dependent entirely upon the governor. Today, however, it is known that the make or type of governor has little or nothing to do with speed regulation, except in so far as it must have sufficient power and proper mechanical adjustments to move the turbine gates in a certain time and without hunting.

Efficiency

Ten years ago it was considered a notable achievement to obtain in a turbine in place an efficiency as high as 82 per cent. The average of the best results secured was in the neighborhood of 80 per cent. The maximum guarantees of the builders were from 78 to 80 per cent. and were considered highly satisfactory.

During the past two years, efficiencies between 89 and 92 per cent. have been quite common, while a maximum value of 93.7 per cent. has been secured. Today the builder must guarantee an efficiency of at least 87 per cent. in order to secure business.

This remarkable increase in efficiency is by no means entirely due to superior runner design. As a matter of fact, the improvements in the design of wheel-casings, wicket gates, draft chests and draft tubes have increased the efficiency of the turbine as much as the more efficient runners.

It is interesting to note that the improvement in turbine efficiency has taken place during the time when the general policy of the power companies toward the builders has changed from one under which a great majority of contracts were awarded to the lowest bidder to the present one under which merit is frequently given first consideration.

Under the former policy, business was secured by the builders at such prices as to allow little or no margin between actual cost and selling price. As a majority of turbine installations undertaken ten years ago were unsuccessful at the start, and required alterations or replacements to make them acceptable, the contracts which showed a profit were few and far between. Thus there were frequently no funds available to cover the cost of experimental work by the builder to improve the quality of his product. As the data

* Hydraulic Engineer, I. P. Morris Co.

available ten years ago was by no means reliable, a majority of the builders had very little assurance of the successful outcome of their work. There was, consequently, a very strong incentive on the part of some of the builders to avoid, if possible, the making of any tests which might prove that the apparatus had failed to meet the guarantees.

Most of the important contracts are now awarded on a basis of merit, and designs and guarantees are given far more consideration than price. A great amount of work is done on a cost and percentage basis, whereby the builder is guaranteed a profit contingent, of course, on the proper execution of his part of the agreement. The ability of the builder properly to construct the apparatus in accordance with his designs is now taken into consideration in comparing competitive designs.

A high guarantee of efficiency is no longer satisfactory to the purchaser unless it can be justified by conclusive evidence in the form of reliable data secured from tests on similar apparatus, or in connection with experimental turbines tested by disinterested parties. The builder who, by the presentation of such data, demonstrates that his guarantees will probably be exceeded, is given preference over his competitor who, although he may have made the same guarantee, is unable to prove that he has an equal margin in reserve.

Engineers of power companies are now taking a much greater interest in the experimental work of the builders than previously, frequently volunteering to share in the expense; provided, of course, that such work will be of some aid to them in selecting the best type of apparatus. In some instances, power companies have allowed under contracts certain sums of money to be expended on experimental work to be carried out by the builder.

In many contracts for waterwheels placed during the last few years the builders have been required to guarantee the efficiency on a bonus and penalty basis, the rate ranging anywhere from $1,000 to $5,000 per unit for each one per cent. of efficiency, the rate in each particular case depending, of course, upon the value of efficiency to the purchaser.

Mor Co-operation

This co-operation on the part of the power companies has been a very important factor in producing the remarkable improvement in efficiency which has been obtained during the past ten years, for it has made possible the expenditure by the builders of very considerable sums of money to cover the costs of research and experimentation. There is probably no doubt in the mind of anyone that the power companies have benefitted many times more than the builders as a result of this experimentation made possible by their liberality.

Another important factor in the rapid strides made in waterwheel design during the past ten years has been the co-operation on the part of the consulting hydraulic engineers who, necessarily, have had a very extended and valuable experience in the design and operation of hydraulic machinery; and in the efforts of builders to solve various problems which present themselves, the advice of these engineers has been eagerly sought and cheerfully given.

The present attitude of the power companies toward the builders has undoubtedly been the result of a better appreciation of the fact that the success or failure of any hydro-electric development depends primarily upon the performance of the turbines. The total investment of a hydro-electric development is represented in the water rights and franchises, the dam and power house, the turbines, generators, electrical transformers, the transmission lines and other equipment. This investment may involve many millions of dollars. The amount paid for the turbines themselves is only a small proportion of the total investment—say from $2\frac{1}{2}$ to 10 per cent. When it is considered that the success of the total development is absolutely dependent upon the proper performance of the turbines, and that the earning power of the total investment may be in proportion to the efficiency of the turbines, the folly of chancing the installation of inferior apparatus is self-evident.

In comparing designs prepared ten years ago with recent designs, the most striking feature is the absence in the latter of sudden turns and abrupt changes of section in all water passages from the turbine casing to the tailrace; and, although in the older designs these passages were thought to be consistent with good results, they now appear to be exceedingly crude. The elimination of losses due to eddies and whirls, abrupt changes of section and sudden curvature in the various parts which constitute the turbine has improved the efficiency of the turbine as a whole.

By means of the Pitot tube, it has been possible accurately to determine the conditions of flow in the various parts of the turbine casing, through the guide vanes, in the space between the guide vanes and the runner, and also in various sections of the draft tube. Thus it has been possible to compare actual conditions of flow in these various parts with the calculations.

Extensive Tests

The waterwheel builders in the past five years have carried on very extensive tests at the Holyoke testing flume in Massachusetts on small runners ranging, in most cases, from 12-in. to 36-in. in diameter. These runners are exact models of the large runners which the builders contemplated installing in the turbines. Various designs of wicket gates and draft tubes are used in connection with the testing of these models. The results of these tests have given the builders very valuable data upon which to base the design of any new work calling for runners of like characteristics. The builders have also been able to secure from these tests empirical constants by which they have been enabled to modify their theoretical data.

The head corresponding to the velocity of discharge from the runner into the draft chest or tube may represent a considerable proportion of the total head acting on the turbine. This is especially true in the case of runners of high specific speed, where this velocity head may be as great as from 25 to 30 per cent. of the total head acting on the turbine. It is, therefore, essential to design the draft tube most carefully, in order to convert this velocity into effective head.

Improvements in the design of draft tubes has been very marked indeed and has resulted in a considerable increase in the efficiency of turbines. It has only been within recent years that hydraulic conditions within the draft tube have been fully appreciated. It was at one time thought that the draft tube was simply a device by means of which it was possible to locate the turbine above tailwater level without losing the effective head represented by the difference in elevation between the turbine and the tailrace. Today, however, the draft tube is looked upon as an extremely important part of the turbine; in fact, it may be said that without efficient draft tubes runners of high specific speeds would be impracticable.

There have been built in times past quite a number of draft tubes with constant diameter from the runner to the tailrace. Consequently, the velocity which existed in the section immediately at the discharge from the runner existed also at the end of the draft tube, and the energy represented by this velocity was entirely lost to the turbine, in addition to the frictional loss resulting from the condition of high velocity throughout the entire length of the draft tube. The efficiency of turbines with draft tubes so designed is necessarily extremely low. By properly designing the draft tube from the section immediately at the discharge from the runner to the tailrace so that the velocity is gradually re-

duced from a maximum at the runner to a minimum at the tailrace, the vacuum in the draft tube may be increased and, consequently, the effective head on the turbine.

Until the last two years a large majority of the turbines installed in connection with low and medium heads were of the old fashioned multi-runner type, consisting of two, four, six and sometimes more runners on a shaft, these runners being grouped in pairs, each pair discharging into a common draft chest and tube. The energy represented by the velocity at the discharge from the runners was practically lost to these turbines, owing to the losses due to impact and eddies and whirls existing in the draft chests and tubes as a result of the runners discharging against each other. Consequently, there was practically no reconversion of the velocity head from the runners into useful head.

Ten years ago the draft chest and draft tube designs of turbines of these types were exceedingly crude. Improvements have been made, of course, from time to time until the multi-runner unit, when now built, is quite an efficient machine. The principal improvements have been in allowing a greater distance between the runners which discharge into a common draft chest, and in designing the draft chest so that the water from each runner is carried into the draft tube to a point where the two streams are moving in parallel directions, before allowing them to converge; but even with the best design of turbines of the multi-runner type, there is always present an appreciable loss due to the comparatively sudden turns which the discharge water from the runners must necessarily follow.

With runners of medium specific speed in a multi-runner setting, it is sometimes possible to obtain efficiencies approaching those developed by the experimental runner, provided, of course, that the draft chests and draft tubes have been carefully designed. In other words, the losses in the draft chest and draft tube about equal the losses which exist at the Holyoke testing flume, where the runner is small, and where the intake and draft tube losses are necessarily appreciable on account of the construction of the flume. On the other hand, should runners of extremely high specific speed be adopted, in which the discharge velocity from the runners represents a very considerable portion of the total head acting on the turbine, it is found that the efficiency seldom reaches that of the experimental model. It may be mentioned that the experimental model is usually operated in a vertical setting, with a single draft tube, and consequently the losses which exist in the draft chest of the multi-runner setting are not present in the experimental setting.

General Design Often Faulty

In many of the power developments carried out a number of years ago, and in some few instances in more modern plants, even such efficiency as could be obtained from the turbines cannot be realized in the operation of the plant as a whole. Poor designs of the waterways leading to the turbine casing and receiving the discharge from the draft tube cause considerable losses outside of the turbine passages. In some instances, much attention has been given to slight variations in turbine efficiency, while losses of head amounting sometimes to one or two feet, occurring through submerged arches, bridge piers or racks, have been overlooked.

Many recent developments are being much more carefully worked out, so that there are gradual transitions in water velocity at entrance to the turbine casing and at discharge from the draft tube into the tailrace; and practically the entire efficiency of the turbine is realized in the operation of the complete plant.

Accompanying a growing appreciation of the value of efficiency, engineers are giving increased attention to the mechanical features of turbine designs and to questions of deterioration of the machinery during operation. It is now realized, especially by those who have been taught by the school of bitter experience, that mechanical reliability and stability of construction are of even more importance than efficiency, since continuity of operation and freedom from interruption for repairs are vital considerations. Among other sources of interruption to service, the deterioration of runner vanes has in the past been a frequent cause of trouble.

Corrosion of Runner Vanes

Corrosion, or pitting of runner vanes, guide vanes and draft tubes, is no longer a serious obstacle to be contended with in the operation of hydraulic turbines as its cause is now pretty well understood and, by correct designing, can be eliminated. Turbine builders do not hesitate to design and construct turbines for operation under any head up to 650 feet and to guarantee their lasting qualities, provided the speed and power in each case are so chosen as to be consistent with favorable hydraulic conditions.

Corrosion, or pitting, must be distinguished from erosion, which is mechanical wear due to the presence of foreign substances in the water. Erosion is entirely a mechanical action, while corrosion, or pitting, is the result of chemical action. The abrasive action of foreign substances in the water has the effect of first polishing the vane surfaces, and eventually cutting away the metal until the vanes are worn entirely through. The eroded parts are, therefore, smooth and can be readily distinguished from the pitted marks which result from corrosion.

The elimination of corrosion as a serious factor in turbine design is the result of a careful study of the subject, after many years of costly experience on the part of both the power companies and the turbine builders. It has been demonstrated that corrosion is primarily a question of design. It has been clearly shown in practice that where sharp curves are resorted to, where contraction is not sufficient, or where there are pockets formed in the surface of the vanes, pitting or corrosion inevitably develops. It has also been demonstrated that where air in large quantities is entrained in the water carried to the turbine, corrosion seems to take place very rapidly if the design is not correct.

While it is true that corrosion takes place more quickly under high heads than under low heads, runners operating under heads as low as 25 to 30 feet have been found in some cases to corrode very rapidly. It is, therefore, essential that the runner be carefully designed, regardless of the head under which it is to operate, but extreme precaution must be taken in cases where the head is excessively high.

A corroded vane surface has an appearance resembling a sponge, the surface being extremely irregular and the pitted spots often opening holes entirely through the vane. Chemical analysis of the corroded surfaces has brought out the fact that the metal has been oxidized. In runners made of bronze or an alloy, modifications in the composition have been detected in the corroded portions.

The theory of corrosion as now generally accepted is that the water in passing over any pocket or depressed surface, or in failing to adhere to the surface of the vane, leaves spaces which are filled with eddies possessing high velocities and very low static pressure, in which oxygen is liberated from the water. This oxygen is believed to be in the nascent state and rapidly attacks the surface of the metal, forming an oxide coating, the greater part of which is rapidly washed away by the water. When once the depth of this pocket is increased by corrosion, it is natural that, due to the greater area exposed, the pitting action should continue at an accelerated rate until the vane is entirely eaten through.

It is quite likely that electrolysis is present as a result of the oxidation of the metal, for it has been noticed in connection with runners of the built-up type—viz., runners in which plate steel vanes have been used with iron or bronze

bands and hubs—that corrosion seems to develop more rapidly than in the case of runners made of uniform metal. Foreign engineers have called attention to the fact that in some instances they have observed that the metal eaten out by corrosion at one section of the runner has apparently been re-deposited at another section, a condition evidently resulting from electrolysis. If electrolysis does exist, it is a secondary action and may be eliminated by first preventing corrosion.

The fact that a runner develops high efficiency under test is not, necessarily, a guarantee that corrosion will not take place. Small defects in the curved surfaces of the runner vanes will be very quickly brought out by the fact that they corrode; while on the other hand these defects in the flow through the runner may be too small to be detected in an efficiency test. In general, however, it may be said that high efficiency and freedom from corrosion are complementary qualities.

While corrosion is primarily caused by defective design, some metals are more susceptible to its action than others. For example, bronze resists corrosion better than does either cast steel or cast iron; but if the runner is so designed as to permit corrosion to take place, it matters little what metal is used. Runners regulated by means of cylinder gates are particularly subject to corrosion, owing to the eddies produced behind the cylinder gates at fractional gate openings.

Corrosion will often develop in a runner if the turbine is operated continuously at low gate openings. The falling-off of the efficiency of a turbine at low gates is an indication that the hydraulic conditions within the runner are greatly disturbed, and this disturbance tends to promote corrosion. High specific speed runners, if applied to high heads, are also subject to corrosion, owing to the high velocities to be dealt with and the difficulty in making the water follow the radical curves characteristic of the vanes of these runners.

Cast Iron Now Used

Cast iron to-day is used as a material for runners to a much greater extent than heretofore and, as a result of careful designing, it has been successfully employed under conditions which, until recently, were thought to be impossible. As an example, in the case of the four 18,000 horse-power turbines operating under a head of 420 feet in the plant of the Great Western Power Company, it might be mentioned that two of the units were equipped with runners of special bronze, the third with a runner of cast steel, and the fourth with a runner of cast iron. These turbines have been in operation since 1908 and a recent inspection has shown all of the runners to be in equally good condition, there being no evidence of serious corrosion in any of them.

Cast steel is thought to be the most undesirable metal from considerations of corrosion, on account of the unavoidable roughness of the surface. In the casting of steel runners it is very difficult to make the metal flow into the thin vane sections without chilling, unless extremely high temperatures are employed. These temperatures often result in the production of uneven surfaces, on account of the difficulty of obtaining sufficiently refractory material for the surfaces of the mold.

Corrosion has often been greatly accelerated because of poor draft tube conditions. It has been only recently appreciated that the total draft head acting on the turbine, or the negative pressure on the discharge side of the runner in feet of water, is equivalent to the vertical distance from the tailwater elevation to the runner, plus the head corresponding to the velocity of the water as it passes through the discharge section of the runner, minus the losses in the draft tube, minus the head corresponding to the discharge section of the draft tube. In modern plants, the last two factors entering into the total draft head have been kept within negligible values.

It is evident that should the total draft head, or the sum of the static draft head and the velocity head at the runner discharge, exceed the height of the water barometer, the continuity of flow of the water on leaving the runner is destroyed. When the absolute static pressure in the draft tube falls to a value equal to the vapor tension corresponding to the temperature of the water, the water will vaporize and the draft tube will not be filled with a solid column of water from the tailrace to the runner. Therefore, the placing of a turbine simply within 34 feet from the elevation of tailwater is no indication that the elevation has been properly chosen; for aside from the limitations outlined above, it is also necessary to allow at least three or four feet margin between the total draft head and a perfect vacuum to prevent the breaking of the column of water in the draft tube due to inertia effects resulting from sudden changes of load on the turbine.

It must also be borne in mind, and this is a point which has been frequently overlooked, that in figuring the margin between the maximum vacuum and the total draft head, the maximum vacuum should be considered for the particular elevation above sea level at which the turbine is to be installed. The fact that the question of draft head has not been clearly understood has resulted in the location of a great number of turbines at such heights above tailwater that the benefit which would otherwise be secured by means of the draft tube has been largely sacrificed. In a number of cases where the draft head has been excessive, corrosion of the runner vanes has developed at a rapid rate, and this corrosion has also attacked the runner band and draft tube in the neighborhood of the runner.

If, therefore, the runner vanes are so designed as to give sufficient contraction to the stream to prevent the water leaving the vane surfaces, if the speed selected is consistent with good hydraulic conditions, and if the elevation of the turbine above tailwater level is properly selected, there is no reason for anxiety over the possibility of corrosion developing to any appreciable extent. In respect to erosion, however, although the best metals are used in resisting its action and high factors of safety are adopted in all parts of the machinery which may be subjected to it, erosion must necessarily be expected wherever the quality of the water is such as to produce it.

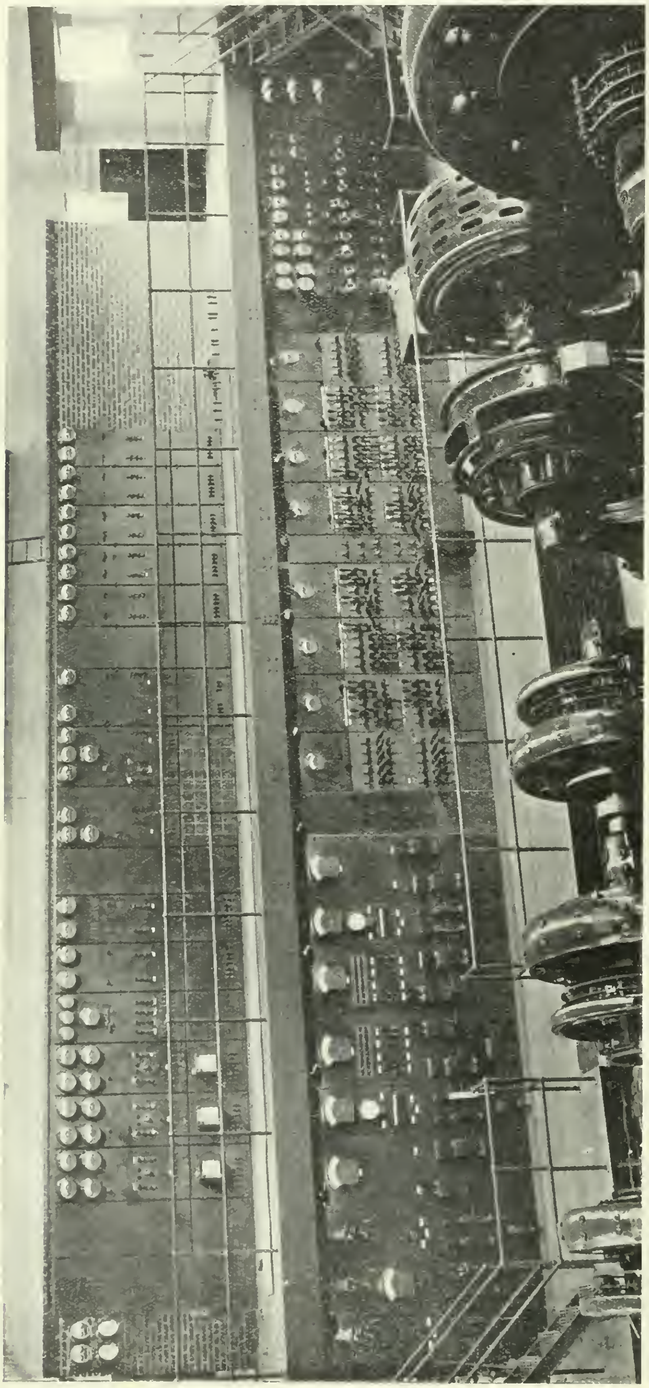
The High Capacity Runner, and the Vertical, Single Runner Turbine

Until two years ago, a very large majority of turbines applied to low heads were either of the vertical shaft, multi-runner type, or, of the horizontal shaft, multi-runner type. The reason for using more than one runner on the shaft which, from a mechanical standpoint, is not desirable, was that this arrangement, permitted high rotational speeds, and, therefore, economic sizes of generators.

During the past two years, however, the general adoption of the single runner, vertical shaft turbine for low and medium heads, has been witnessed. This change in the type of unit has been made possible by recent progress in the design and development of high capacity runners. Thus, for a given head and speed it is now possible to secure from a runner a greater output than was possible two or three years ago; or, conversely, for a given head and capacity it is possible to operate the more recently designed runners at a much higher rotational speed than was the case with runners designed a few years ago. This increase in the capacity of runners has been secured without a sacrifice of maximum efficiency and with only a small sacrifice in the efficiency at fractional loads.

(To be concluded in Feb. 15th issue)

Modern Switchboard Practice at its Best



The new switchboard recently installed by the Toronto Electric Light Company, at their Scott Street station and illustrated herewith represents the latest and most approved practice in switchboard design, construction and installation. That part of the switchboard installed in the gallery as shown in the upper part of the picture represents the 12,000 volt remote control which controls all feeders, turbines and converter sets. On this board, along with the usual equipment of switches and instruments, green and red lamps are installed on each circuit, the green indicating that the circuit is open, the red that the circuit is closed. An interesting and valuable feature in this connection is a dummy bus panel occupying the lower part of two of the panels near the centre of the board on which the bus structure, switches and lamps are represented in miniature, giving the operator, at a single glance, a knowledge of the condition of the complete system. Directly behind the brick wall shown are the 12,000 volt switches which board controls, and below on the ground floor are the main 12,000 volt bases and 12,000 volt type H3 oil switches.

The lower board controls all 230 volt d.c. buses. Of this board the first nine panels on the left are for the control of the storage battery sets. The tenth panel controls the station lighting and auxiliaries. The next four panels control 40 positive feeders. As these panels have a width of 30 inches it will be seen that by grouping the positive feeders together it has been possible to economize greatly in the length of board as two feeders occupy only six inches in length. The close proximity of these feeders detracts nothing from their absolute safety as they are all of the same polarity and have the same voltage. So far as we can learn this is a unique practice in central station work in Canada.

The next or fifteenth panel from the left controls the circuit breakers on the net-work. These sectionalize the d.c. system into two sections, one feeding from this station and one feeding from the Terauley Street station, where this panel is duplicated for this purpose.

The next four panels control the negative feeders corresponding to the four positive feeder panels already described. As with the positive panels the same economy of space has been introduced with absolute safety.

The next panel is a blank and the five panels to the right are remote control machine panels arranged for two machines on each panel. The main circuit breakers and the main and auxiliary machine buses are located in the basement immediately underneath.

All wiring is carried in conduit set in the cement floors and the work at the back of the switchboard represents a piece of construction so well planned and executed that it must be seen to be appreciated. This work was carried out under the supervision of Mr. S. Bingham Hood for the company. The battery board was supplied by the C. G. E. Co. and the other boards by the Northern Electric & Mfg. Co.

Testing of Telephone and Telegraph Lines*

By Mr. T. H. Nicholson

In order to clearly follow the operation of a test circuit it is necessary to know the complete composition of the line or group of lines to be tested. All telephone lines must necessarily have some apparatus connected to them for signalling purposes, and of course some arrangement to remove this apparatus from the line when it is being used for transmission purposes. In some systems the signalling apparatus is also used for talking battery supply and for supervision, while in others the apparatus is removed by means of cut-off jacks. However, for the sake of simplicity we will here consider a system using a separate line and cut-off relay, the cut-off relay being actuated by the operator's cord circuit. This fulfils our earlier assumption of a three wire system and permits of better explanation and understanding of methods to be followed.

Fig. 23 shows the wiring in schematic form, omitting all

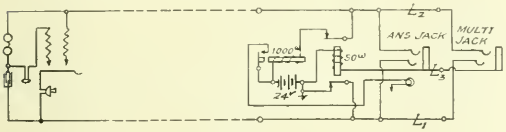


Fig. 23.

cross wiring, etc., of a conventional subscriber's line of the type above spoken of, and while it does not conform to any definite standard, it resembles several systems enough to permit of readily applying the tests given with it to others.

All tests will be assumed as being made from the multiple jack shown, and using the wires L_1, L_2 and L_3 to correspond with similar wiring in the test circuit. The third wire or L_3 should be connected from the central office battery through a resistance equivalent to that in the operator's L_3, so that the cut-off relay will be properly operated and the line apparatus removed.

To make a complete test of a subscriber's line it is necessary to make a definite number of tests in some order or another, and additional tests to locate trouble which may be found. For the present we will confine our attention to those necessary for a routine test, leaving trouble location to follow.

The required tests and their order may be as follows:

(1) Test line for continuity.
(2) Test instrument for capacity.
(3) Test sides of line for insulation.
(4) Test line and cut-off relays.

These four general tests require several functions of the test circuit each, and as a large number of these must be made it is desirable that they naturally follow one another in the key operation as far as possible. These functions may in turn be classed as follows, each item comprising a different arrangement of the test circuit:—

(1) Metallic line test for cross.
(2) Test of L_1 for ground.
(3) Test of L_2 for ground.
(4) Continuity of line and instrument test.
(5) Test of line and instrument for resistance.
(6) Test of L_3 for resistance.
(7) Test line relay, L_1 side.
(8) Test of line relay, L_2 side.
(9) Calling operator with test circuit.
(10) Calling operator through subscriber.

These ten functions will give a fairly complete routine test on a regular subscriber's line that has no special arrangement, and in an exchange where no unusual operation is followed.

The circuit shown in Fig. 24 is one designed to provide for all of the above under these conditions and of course can be extended to include additional tests as found necessary. It will be noted that the keys are all shown single, and that they are all arranged in an order that seems fortunate for ease in wiring. They are shown in this manner, however, in order to make the circuit more easily understood. Any kind of keys that will give the necessary operation will do, and further they may be combined into double keys if desired, always considering the operation, however, and whether any two functions in question will ever need to be operated together.

Explanation of Circuit

Referring to the figure, it will be noted that the voltmeter is already connected through the test battery on to L_1 and L_2, so that no operation is necessary for this feature. Key No. 1 opens L_1 and grounds the test battery, thereby providing for a test on L_2. Key No. 2 reverses L_1 and L_2, and grounds the L_1 side of test circuit and permits of testing L_1. Key No. 3 simply reverses L_1 and L_2 for any test requiring such reversal. Key No. 4 is a ringing key, simply opening the test circuit and ringing out. Key No. 5 bridges the telephone across L_1 and L_2 for talking purposes. Key No. 6 provides talking battery on the line, for use on common battery instruments. Key No. 7 reverses L_3 and L_2, and grounds L_1, thus giving a test of L_3. Key No. 8 opens L_3, to permit operation of cut off relay,

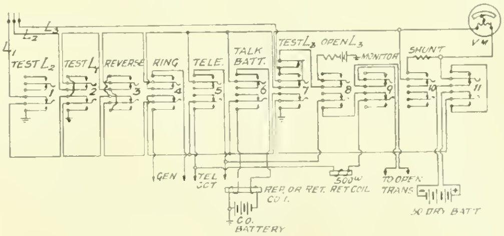


Fig. 24.

and puts a coil across L_1 and L_2 to operate the line relay. Key No. 9 opens this coil when key No. 8 is operated, and also opens transmission circuit, so that tester can monitor on lines without interferring. Key No. 10 shunts the voltmeter, and key No. 11 opens the voltmeter battery circuit, and closes the voltmeter direct on the line for measuring other currents.

A very satisfactory street lighting system has been installed in the town of Taber by the Canada West Coal Company, Limited, which company supplies power and light throughout the town. This company operates two 150 kw. direct current Goodman generators and a 150 kv.a. Electric Machine Company alternating current unit all operated by Ideal steam engines. The street lighting system in the business section consists of 30, 2 arm iron brackets each carrying two 100 watt lamps. In the residential section 100 Cutter boulevard brackets with single lights have been installed, so that for a town the size of Taber this represents a very satisfactory illumination.

Electric Railways

Statistics and Prospects in the Canadian Electric Railway Field — The Past Year One of Marked Progress — The Present Year One of Great Promise

In looking over the electric railway situation in Canada at the present time one is forcibly impressed with the evidence that we are on the threshold of a great development. Up to the present time electric operations have been confined more or less to cities and large towns and little attention has been paid to interurban work, this being left to the slower and more unwieldly steam railway systems. Present indications are, however, that the next few years will see a decided change in this situation. During the past year a very noticeable advance is shown in the decision of the C. P. R. to electrify the mountain section of their branch between Rossland and Castlegar, and in the work undertaken by the C. N. R. in tunnelling through Mount Royal and equipping their Montreal terminals electrically. Both of these equipments call for operation at 2400 volts which becomes a record in Canada. In this connection it is pleasing to note that Canadians are leading in the matter of high voltage railway electrification in that there is only one system operating at this voltage on the American continent and the second and third systems will be those mentioned above. Contracts for the fourth 2400 volt system have since been let in the United States. These systems cannot, of course, be considered as strictly interurban lines as the traffic requirements will be very heavy.

As indicating the tendency in purely interurban construction it is, however, interesting to note the decision of the Toronto Suburban Railway Company to operate their new western line at 1500 volts d.c. A contract was recently awarded to the Canadian General Electric Company for the complete construction apparatus and car equipment for the new line of this company which will run west from Toronto through Georgetown to Guelph and later to Berlin. This is the first interurban line in Canada which will operate at 1500 volts d.c. The catenary type of overhead construction will be used and there will be three sub-stations in this distance, namely, at Islington, Georgetown and Guelph. 1500 volt rotary converters of 500 kw. capacity each will be used, power being transmitted to the sub-station at 25,000 volts. The cars will be equipped with four 85 h.p. motors of the latest type, fully ventilated; the control will be of the multiple unit type to permit of train operation. These cars will be capable of operation at 600 volts at approximately half normal speed and the motors will be so designed that the change from the higher to the lower voltage, and vice versa, can be made as conditions demand. The 1500 volt line project will be about 62 miles long. Provision will also be made along this line for the supply of power, by the installation of a separate bank of transformers in each sub-station. This power will be distributed for miscellaneous power and lighting purposes.

Possibly the promise of greatest development in the near future lies with the Hydro-electric Power Commission of Ontario. The engineering department of the commission has been quietly but very vigorously engaged in the collection of valuable and accurate information on the railway possibilities in many different sections of Ontario. Surveying parties have been constantly at work and information of a most accurate and complete character has been compiled wherever it has seemed possible that a railway system was likely to be required, or, if required, to be a feasible proposition. At the present time information of this character is on file at the commission's offices covering some 400 miles of possible lines and in the near future this information will be supplemented by similar data covering another 200 miles.

The districts projected already include the Markham, Whitby, Port Perry and Uxbridge section, approximately 80 miles; a network of lines covering Huron County aggregating approximately 215 miles; a projected line from London to Sarnia of 88 miles; a line from Stratford to London by way of St. Marys of 36 miles; and a line connecting St. Thomas with Windsor, something over 100 miles, making a total of over 600 miles. In addition to this, requests have come in from other sections and information will be gathered in due course. With this data ready, the commission will await only the authority of the municipalities to proceed with the work.

A noticeable change has taken place in the attitude of the Hydro Commission towards the construction of electric railways in that the apparent apathy of a year ago has given place to an almost enthusiasm in the belief of the possibility of many of these lines to become a financially paying proposition. In a number of sections surveyed it has been shown that the passenger traffic can be very largely supplemented by the carrying of farm produce and freight in its many different forms, and this feature is particularly applicable in the better farming districts. The most progress appears to have been made in connection with the Markham district and a printed report was issued some little time ago covering the estimates for railway lines in this vicinity. The report states that a 2400 volt direct current system has been used in figuring the cost of the electrical equipment but that the layout and traffic should give similar results with a single phase a.c. or 1200 volt direct current systems. The report goes on to say that while these systems will be more expensive in first cost and operating expenses for a short line than the low voltage direct current system, that has been so long standard in Canada, they are necessary for a line of this type in order that holiday or special traffic may be properly handled without the capital cost being raised to an amount that would cause unusually heavy expense for normal operation. These systems have also been chosen, the report states, in order that the line may be able to take care of freight traffic and to be extended short distances without installing additional sub-station equipment and trolley feeders. In the Markham district five schemes have been suggested which vary in total capital cost per mile from $49,800 to $41,300, the shorter schemes working out, of course, the most ex-

pensive. This would be reduced in each case by $6,500 per mile, as the government has promised to subsidize the roads to that extent.

The electrification of the London & Port Stanley, a steam road owned by the municipality of the city of London, and at present operating as a steam line, has been decided on during the past year. Engineering features, if determined, have not yet been made public but it is understood that work will proceed early in the present year and that the work of electrification will be completed, if possible, before the year is out.

Among other noticeable features of the year may be noticed the very rapid growth in popularity of the p.a.y.e. type of car which is now being used almost universally. The gas-electric has not made as rapid progress as might have been anticipated. One car of this type is now operating out of Edmonton and two on Vancouver Island in addition to the pioneer car operating on the Quebec and St. John Railway. With the larger extensions in the interurban field this car may look for greater popularity. It has been announced that the Ottawa & Morrisburg line will probably be equipped with this type of car; also the Lacombe and Blindman Railway.

Another sign of the times is the decision of the Dominion Power & Transmission Company to build a large auxiliary steam plant so that they may be in a position to guarantee continuous service at all times.

Among the smaller enterprises the street railway for Stratford which seemed possible a year ago now looks to be farther in the future than ever. The Medicine Hat system is held in abeyance until certain legal questions, now pending, can be settled. The Grand Valley Railway and the Brantford Street Railway are still in the hands of a receiver, and it seems most probable that the Brantford end of it at least will be taken over by the municipality. The Three Rivers city line as well as radial lines in the vicinity are still in the future. The Forest Hill line which was to operate in the immediate vicinity of North Toronto has made no move as yet towards construction work. The Ottawa, Rideau & Kingston have made no report of progress. The Humber Valley railway is also held over, and the same is practically true of the Toronto Eastern. Among the newer promotions may be mentioned the Quebec & Isle of Orleans; the Sudbury, Copper Cliff Surburban; the London, Grand Bend and Stratford; a private system in Prince Albert, Sask.; the Imperial Traction Company; Estevan Transit and Power Company; Suburban Railway Company, St. John, N.B.; and the Alberta Metropolitan Railway Company. Work on any or all of these, however, may be pushed forward during the present year.

Brief notes on the operation of the different Canadian companies with their prospects for the coming year are given below. On account of financial conditions many of the companies are reticent about expressing themselves on probable extensions during 1914, but enough information is given to show that a tremendous amount of work is under contemplation.

It is now reported that Sir Donald Mann has stated that work on the branch railroad line from Kamloops to Vernon and south down the Okanagan Valley will be started in the near future. Sir Donald is stated to have said that this line will be electrified, power being obtained by a development at Couteau Falls.

A further item of interest to electric railway men is the entrance into the manufacturing field of the Tillsonburg Electric Car Company; also, for a certain class of railway car, of the Canadian Car & Foundry Company. It has been noticeable on different occasions that our railways have found it necessary to go outside of Canada for their rolling stock and other equipments and with the certain increased activities of the near future there will be more than enough orders to go round. The awarding of contracts for new cars in the recent past has been largely determined by the ability to make delivery.

British Columbia Electric Railway Co.

This company has still much the largest system of lines in Canada with a total mileage at December 31, 1913, of 370.09. During the past year the lines around Vancouver city were extended by the addition of some ten miles, but a larger development was shown on Vancouver Island where the Victoria city system was extended up the Saanich penisula some 26 miles, opening up a very rich agricultural and summer resort district. During the year the company have added to their rolling stock three double track passenger cars built in their own shops, 60 freight cars, 3 sweepers, 15 logging cars and two combination passenger and mail cars. The total equipment at present consists of 902 cars.

Berlin & Waterloo Street Railway

This company has added two 45 ft. double truck passenger cars during the year and one and three-quarter miles of track. During 1914 they will extend their track by another mile and add another double truck car.

Brandon Municipal Railway

Two miles were added during 1913 and ten single truck cars, ten trailers and a snow sweeper were put on the lines; these representing the total rolling stock to date. It has not been decided yet what extensions either of rolling stock or of track will be made during 1914.

Calgary Municipal Railway

This system added 10½ miles during 1913, bringing the total up to 70 odd. They also added during the year 12 41-ft. and 12 46-ft. motor cars and 6 40-ft. centre entrance trailers, bringing the total rolling stock up to 84. During 1914 at least five miles of track will be laid and 6 more 41-ft. cars will be placed on the line. Calgary now has more mileage per thousand of population than any city in Canada, having 70.5 miles to a population of approximately 85,000 or almost a mile per thousand people.

Cape Breton Electric Company

This company controls the Sydney & Glace Bay Railway Company, and altogether about 32 miles of line is operated. During the past year the Sydney & Glace Bay Railway Company have added three double truck cars and at the present time are installing two synchronous motor generator sets of 300 kw. capacity.

Chatham, Wallaceburg & Lake Erie Railway Co.

No extensions either to track or rolling stock were made during the past year. Two K11 Westinghouse controllers with the necessary switches and circuit breakers were installed.

Dunnville, Wellandport & Beamsville Electric Ry. Co.

Sixteen miles were under construction during 1913 from Dunnville to connect with the Canadian Pacific Railway at St. Anns. It is expected this will be placed in operation during the present year and the line extended on to St. Catharines. On this 16 miles the grading is pretty well completed and all bridges are finished; part of it is tied and ready for steel rails.

Dominion Power & Transmission Company

This company controls the Hamilton Street Railway Company, the Hamilton & Dundas Street Railway Company, the Hamilton Radial Railway Company, the Hamilton, Grimsby & Beamsville Electric Railway Company, and the Brantford & Hamilton Electric Railway Company. Eight miles were added to the Hamilton Street Railway and 12 double and 12 single truck cars during the past year. No additions were made to any of the other lines. The Hamilton & Dundas now consists of 7 miles of track, the Hamilton Radial of 32 miles of track, the H. G. & B. of 23 miles, and the B. &

H. of 23 miles. In addition the parent company controls the Hamilton Terminal Company, which owns a considerable amount of rolling stock. The total rolling stock of this extensive system is some 180 cars of all kinds.

Edmonton Radial Railway

Very extensive development work was carried on by the city of Edmonton during the past year which consisted in track extensions to the amount of over 20 miles, and additions to rolling stock of 32 cars. At the present time the city operates about 53 miles of single track and 79 cars of all sorts. During 1913 new car barns and shops were completed at a cost of $250,000 which are thoroughly equipped with modern machinery so that the department can make all necessary repairs to railway stock. During the present year it is not expected that as much extension work will be undertaken. At least 7 passenger cars will be required, however, and an amount of track work will be carried out which has not yet been determined.

Edmonton Interurban Railway Company

Nine miles of interurban line were completed during the past year, connecting Edmonton with St. Albert. On this line one gasoline electric car is operating at the present time and we understand two other cars of similar type and one work car will be added to the rolling stock during the present year. Three miles of additional track will also be required.

Fort William Electric Railway

The Fort William Electric Railway and the Port Arthur Electric Railway, which were formerly operated under a combined management, have now been divorced and will continue operation as two entirely separate systems, though certain arrangements will allow for a through service between the two cities. The city of Fort William operates at present about 12 miles of line and it is expected that a belt line of about four miles will be added during 1914. It is also the intention of this municipality to add to their rolling stock five single truck, double end, p.a.y.e. cars, now on order, and one snow sweeper, also on order. The rolling stock at the present time consists of 17 double truck motor cars, two single truck motors and three double truck trailers. A considerable sum of money was spent during 1913 on car barn additions.

Grand Valley Railway Company

This company, which operates between Galt and Brantford, also controls the Brantford Street Railway system. The company's affairs have been in the hands of a receiver during the past year and it is not yet determined what will be the outcome of certain points at issue between the city of Brantford and the company. Present indications are that the city may take over the system and operate it municipally, that part at least which is within the city limits.

Guelph Radial Railway

This company has added a double end, double truck, p.a.y.e. car to the rolling stock, which brings the total to 17 cars of all kinds. During the next year two double and quadruple equipment p.a.y.e. cars will be added.

Halifax Electric Tramway Company

During 1913, six closed cars and a little over two miles of line represent the extension work of this company. The total trackage is now approximately 22 miles with 60 cars.

Hull Electric Company

1.4 miles, bringing the total to 28 miles, were added during the year and 4 trailer cars, now on order, will be added to the rolling stock during the early part of the coming summer. During the present year track extension work will consist of double tracks on certain of the city streets and certain other extensions to the city lines, but no definite decision has yet been reached as to the extent of this work.

International Transit Company

During the past year this company extended their line by approximately one-half mile. The rolling stock now consists of eight motor cars and three trailers and two motor cars will be required during the present year, though it is improbable that further track extensions will be made at present.

Kingston, Portsmouth & Cataraqui Electric Railway Co.

The present eight miles of line will be extended by one-half mile during the coming summer. The rolling stock consists of 29 passenger cars, 2 sweepers and 1 work car.

Lacombe and Blindman Valley Railway

According to latest reports good progress is being made with the survey and grading of this road, which will run from Lacombe, through Gull Lake and along the Blindman river valley. It is said 100 men are at present at work.

Levis County Railway

The trackage consists of 12 miles and the rolling stock of 22 cars. No extensions have been made during the year.

London & Lake Erie Railway & Transportation Co.

During the past year this company have changed over from their own steam power plant to Niagara power supplied by the Ontario Hydro Commission. During the present summer they expect to extend their line by some 30 miles, which will more than double their present system. During the past year two baggage and express cars were added to the rolling stock. It is unlikely that additional rolling stock will be purchased during the present year though this will be necessary as soon as the proposed extensions are built.

London Street Railway Company

The total length of track now stands at 35, being increased by one mile during the past year. The rolling stock has also been increased by 6 single truck p.a.y.e. type cars, one of which was described briefly in a recent issue of the Electrical News. It is improbable that extensions either to rolling stock or track will be undertaken during 1914. The total rolling stock consists of 60 cars of various types.

Lethbridge Municipal Railway

It has not yet been determined what extensions will be made either in trackage or in rolling stock during the present year. At the present date ten cars are operating on 10½ miles of line.

Montreal & Southern Counties Railway

This company is rapidly extending its line as is shown by the 22-mile addition during 1913, with 24 miles more to be completed this year. The present mileage is 32, which at the end of the present year's operations should be 56. During the year 6 passenger, 2 combination express and passenger and one double truck sweeper have been added, and during the present year 10 passenger and 2 express cars will be required.

Moose Jaw Electric Railway Company

This company added five miles of track during 1913 and will complete another five miles this year and bring the total mileage up to twenty. Fourteen single truck p.a.y.e. cars were added in 1913, bringing the total rolling stock to 22 and 1 sweeper. This company use Diesel oil engine generating equipment and will install another 500 h.p. unit during the year. In 1913 a 500 h.p. unit was installed and the new unit will be a duplicate of this one.

Morrisburg & Ottawa Electric Railway

Ten miles of grading are practically completed by this company and during the present year it is hoped this will be extended to 25 miles, and placed in operation. Rolling stock requirements will therefore be considerable and will consist of three locomotives and 20 other cars for use during construction and of 6 passenger and 20 freight cars for operation of the line when completed. It is the present intention to

use either gas-electric cars or gas-electric in part and straight electric in part. A right-of-way has been secured for the entire route. At the recent January elections the village of Chesterville voted a bonus of $5,000 to cover extensions through that village and a year ago the city of Ottawa voted them terminal rights in Ottawa. At the present time bonds to the extent of $1,000,000 are being placed on the market to take care of further operations.

Moncton Tramways, Electricity & Gas Co.

This company now operate five miles of line, one mile being completed during the past year. Considerable extension work will be done in 1914, consisting of from two to four miles of track and the company will require four or five new single truck cars for passenger service. New generating equipment will also be required and it is likely this will take the form of a 300 kw. a.c. unit and a 150 kw. motor-generator set. The company will also install high pressure boilers in place of the low pressure tubular boilers now in use though it is understood these changes will not take place until somewhat later in the year.

Nelson Street Railway

The Nelson railway system has now been taken over by the city and will be operated as a municipal enterprise. Three cars are operating on about 1½ miles of line, but during the present year it is the expectation that some additions will be made to both track and rolling stock.

Niagara, St. Catharines & Toronto Railway Company

An extension from St. Catharines to Niagara-on-the-Lake has been completed and recently placed in operation, adding 12.2 miles to this company's lines which now total 76 miles of single track. During the year four semi-convertible passenger cars, one electric locomotive and one snow sweeper were added to stock and during the present year six interurban passenger cars, already under order, will be placed in operation. A sub-station will be placed at Niagara-on-the-Lake to feed the extreme section of that line. The total rolling stock comprises 42 passenger cars, 36 freight, 6 miscellaneous and 6 locomotives.

Niagara Falls, Welland & Lake Erie Railway Company

This road is now operating 3 single truck cars and 1½ miles of line and it is expected that the mileage will be increased this year by the addition of 2.8 miles. Probable requirements in rolling stock include 1 single truck car and 2 interurban cars. A new 300 kw. rotary converter with necessary transformers, switches, etc., will also be purchased.

Nipissing Central Railway Company

No extensions to this line have been made during the year, but it is expected Cobalt will be connected with Kerr Lake by a 4-mile line during the present summer. This will bring the total of the system to about 15 miles. One combination motor, and snow plow were purchased this year and two interurban cars will be required for the additional line. There are at present six interurban passenger cars operating.

Oshawa Railway Company

One-half mile of siding was added during 1913 and only similar work will be carried on during the present year. The company has at present on order a new motor-generator set which it is expected will be operating within the next few weeks. Two closed passenger cars were added during the year. This company does a considerable amount of freight carrying.

Ottawa Electric Railway Company

Five miles of single track were added last year, bringing the total to 55. Twenty double truck steel cars, p.a.y.e. type, 45 ft. 3 in. long, were added to rolling stock as were also two double truck locomotive type sweepers. No extensions to the line are being considered for 1914 and track work will be confined to renewals. The rolling stock will be added to, however, by ten double truck steel cars similar to those added in 1913. The rolling stock of the company at present consists of 176 cars, 13 sweepers and 3 wing plows. The type of plow used by this company was illustrated in the January 15 issue of the Electrical News. During 1913 two sub-stations were erected and placed in operation, each containing 1—500-kw. Westinghouse motor-generator set.

Peterboro Radial Railway Company

One-quarter of a mile of track was rebuilt last year and the total trackage now stands at something over six miles. It is expected that one mile of this will be rebuilt during 1914. During the year two 9-bench open trailers were added to stock which now consists of nine semi-convertible cars and five trailers.

Port Arthur Municipal Railway

The municipality of Port Arthur built approximately five miles of line in 1913, bringing their total up to between 17 and 18 miles. Six cars were added during the past year so that the total is now 21 and two more cars are on order. At least one-half mile of line will be constructed this year but the plans are not yet complete.

Pictou County Electric Company

9.1 miles of track are now operated by this company, 1 mile having been added during the past year. The line will be further extended this year about 1 mile. Three passenger cars and one snow plow have just been added, and additional rolling stock to the extent of two passenger cars will be required in the near future.

Quebec Railway, Light, Heat & Power Company

About two miles have been added to the city division of this company during the past year, bringing the total to approximately 24 miles. No rolling stock has recently been added and it has not yet been decided what extensions will be required for the present year. The total passenger rolling stock consists of 11 cars. No changes have been made on the Montmorency division.

Regina Municipal Railway

This system is developing very rapidly, 21 miles being constructed during the past year, which brings the total to 30 miles single track. During the year also six double truck passenger cars, six single truck passenger cars, and one motor haulage car were added, which with one single truck sweeper, one double truck sweeper, six dump cars, five flat cars and eighteen garbage cars now comprise the total rolling stock. During 1913 there were four miles of single track reconstructed from gravel ballast to permanent paved track. Further extensions to the amount of three miles will be added this year, also a sprinkler and six double truck passenger cars.

Saskatoon Municipal Street Railway

This municipality now operates 15 miles of line, the year's additions consisting chiefly of a line connecting the city of Saskatoon with Sutherland, a village three miles distant. This line was built by certain real estate interests and handed over to the city of Saskatoon for operation. It is the intention to maintain a half-hour service on this line, operating two cars. In 1913 six double truck passenger cars were added and during 1914 another half dozen trucks will be required and certain line extensions not yet decided upon will be made. A 500 kw. rotary converter will be added to the generating equipment.

Sarnia Street Railway Company

No extensions were made during 1913 but about one half mile of track is to be built this year. Ten cars are operating on 9¼ miles of track.

Sandwich, Windsor & Amherstburg Railway

One and one-half miles built in 1911 brings the total of this company's line to nearly thirty miles. Four single truck

p.a.y.e. cars were added to rolling stock which now totals 53 cars. During the present year two double truck cars and two single truck cars will be added to rolling stock and three miles of track will be built. This company operates the Windsor & Tecumseh Electric Railway, which has single track in addition to the above of approximately ten miles.

St. John Railway Company

The city of St. John is showing very satisfactory evidence of industrial activity. During the year the railway company added 1½ miles to their line and next year will complete another three miles of track. Thirteen cars were added during the year and six more will be added. The total rolling stock now includes 38 closed, 25 open and 1 work cars, 3 plows and 4 sweepers. An addition is being made to the generating equipment by a 2,000 kw. steam turbo-generator, which is at present being installed.

St. Stephen Electric Railway Company

This road is leased and operated by the Calais Street Railway of Calais, Maine. The system consists of only three miles.

St. Thomas Municipal Street Railway

No additions have been made either to track or rolling stock and it is not yet determined what extensions will be made during the present year. Seven miles of track are operating.

Sherbrooke Railway & Power Company

No extensions to track or rolling stock have been made recently and it is not yet settled what work will be done this year. The company operates 11 miles of track with 19 cars, 1 sweeper and 1 plow.

Toronto Railway Company

About two miles of track were added last year, consisting of cross-town lines designed to relieve the congestion in the neighborhood of King and Yonge. The total single track now operating is approximately 121 miles. During the year 100 new cars were added to rolling stock bringing the total, including motors and trailers, to something over 1,000 cars. It is not probable any considerable extensions will be made this year pending the negotiations with the city of Toronto.

Toronto & York Radial Railway Company

No additions have been made to track or rolling stock during the past year though considerable extension work has been done in connection with the distribution system maintained by this company in the towns and municipalities north of Toronto. A very efficient system of street lighting and power supply has been installed in the town of Aurora, and at the present time equipment for their waterworks is being installed. The company operates in all 82 miles of line with 91 cars.

Toronto Suburban Railway Company

During the past year an extension to Woodbridge was about completed and will be placed in operation this spring. This extension consists of approximately seven miles, which will bring the total mileage up to twelve. During the year four passenger cars were added and the total rolling stock is now 14 cars. During the year a considerable amount of grading was also done on the extension of this line west from Lambton to Georgetown to Guelph. From Lambton to Georgetown is approximately 26 miles and from Georgetown to Guelph 20 miles. As stated elsewhere in this article it is the intention to equip this line, with a further extension to Berlin, with 1500 volt apparatus. It is probable that during the present year three sub-station equipments will be put in and that at least ten new cars will be required in addition to other electrical equipment for building at least 46 miles of line.

Toronto Civic Railway

The municipality of the city of Toronto now operates 16.84 miles of track, having added 4 miles during the past year. The total is made up as follows:—Gerrard St., 3.66 miles; Danforth Ave., 6.82 miles; St. Clair Ave., 6.36 miles single track. The total rolling stock now consists of 20 double end control, 4 motor equipment, centre aisle, p.a.y.e. cars, 44 ft. 5 in. over all, and 1 sweeper. A quantity of construction work is under prospect for the present year but nothing has been decided.

Windsor, Essex & Lake Shore Railway

No additions to track were made last year so that the mileage still stands at 38. It is expected two passenger cars will be added to rolling stock during the present year.

Winnipeg Electric Railway Company

This company controls also the Winnipeg, Selkirk & Lake Winnipeg Railway and the Suburban Rapid Transit Railway. The Winnipeg Electric Railway Company proper have added to their rolling stock 40 motor cars, 2 flat cars, and 1 trailer. The total mileage is now 100 and the total passenger rolling stock 340. The Winnipeg, Selkirk & Lake Winnipeg Railway added 8 miles of track during the year and now operate 32 miles. The Suburban Rapid Transit Company operates 19.6 miles. No decision has yet been reached as to the extensions to any of these lines during the coming year.

Yarmouth Electric Light Company

This company operates 4 miles of track and during the year added two single truck and two motor cars to their rolling stock. The railway is operated by a synchronous motor-generator set situated in the town sub-station supplied by power brought 18 miles from Carleton over a 22,000 volt transmission line.

Summary

	No. miles added 1913	Total miles	No. miles to be built 1914	No. new cars 1914
Berlin & Waterloo	1.75	5	1	1
Brandon Municipal	2	8	..	..
Brantford & Hamilton	....	23	..	..
B. C. E. R.	36.07	370.09	.	..
Cape Breton Electric	....	31.5	..	..
Cornwall Street Railway Co.	....	31.5	..	..
Calgary Municipal	10.5	70.5	5	6
C. W. & L. E.	....	40	..	..
D. W. & B.	....	....	16	..
Edmonton Municipal	20.3	52.6	..	7
Edmonton Interurban	9	9	3	3
Fort William Municipal		12	4	6
G. P. & H.		22	..	..
Guelph Municipal		8.5	..	2
Grand Valley		47.4	..	..
Hamilton Street Railway	8	26		..
Hamilton & Dundas		7	.	..
Hamilton Radial		32		..
H. G. & B.		23	.	..
Halifax Electric	2.1	21.6		..
Hull Electric	1.1	27.9	.	4
International Transit	.5	4.1	..	2
K. P. & C.		8	.5	..
Lethbridge Municipal		10.5	..	..
Levis County		12	..	..
L. & L. E.		29	30	..
London	.7	35	..	..
M. & O.	10	..	25	29
M. & S. C.	22	32	24	12
Moose Jaw	5	15	5	..
Montreal Tramways		240	..	..
Moncton Tramways	1	5	4	5
N. F. P. & R		24.5	..	..

N. S. & T.	12.2	76	..	6
N. W. & L. E.	.85	1.52	2.8	3
Nelson Municipal	....	2	..	..
Nipissing Central	....	10.5	4	2
Ottawa Electric	5	55	..	10
Oshawa	.5	6.5	.5	..
Peterboro Radial	.25	6.1	1	..
Port Arthur Municipal	5	18	.5	2
Pictou County	.7	9.1	1	2
Quebec R. L. H. & P.				
City Division	1.9	23.9	..	..
Montmorency Division	....	28	.	..
Regina Municipal	21	29.75	..	7
Saskatoon Municipal	....	15	.	6
S. R. T.	....	19.6	..	..
S. W. & A.	1.4	39	2	4
St. John	1.5	20.5	3	6
St. Stephen	....	3	..	..
St. Thomas	....	7	..	..
Sarnia	....	9.3	.5	..
Sherbrooke	....	11	..	..
Toronto Railway	2	121	..	..
Toronto Suburban	7	12	46	10
Toronto & York	....	82	..	..
Toronto Eastern	20	..	..	..
Toronto Municipal	4	16.84	..	..
W. E. & L. S.	....	38	.	2
Winnipeg Electric	18	100	..	..
W. S. & L. W.	9.8	31.9	.	.
Yarmouth Street Railway	....	4	..	..
Total	241.42	2080.20		

Track Construction in Edmonton

During 1913 the city of Edmonton constructed 21.714 miles of electric railway. The construction used entirely last year was 80 lb. A. S.C.E. rails and granolythic construction between the tracks reinforced as shown in Fig. 1 herewith. The reinforcing consists of No. 10 gauge expanded metal 3-in. mesh, placed approximately 1½-in. below the upper surface of the concrete as indicated in this figure.

Fig. 1 may be said to represent the type of construction adopted by Edmonton during the past year as standard. The subgrade is prepared true to grade and the whole surface of the roadway is thoroughly consolidated by rolling with a ten-ton steam roller or, when inaccessible to the roller, by ramming. The first layer consists of a concrete base six inches in thickness of the proportion of one part cement, three parts sand and six parts crushed stone or gravel. When this concrete base is sufficiently set the city

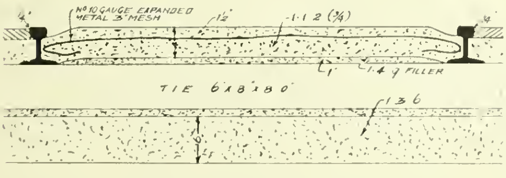


Fig. 1.—Standard construction in Edmonton

assembles and leaves to rough centre the skeleton track which includes ties, rails, fastenings, bond work and overhead work.

Under each tie when the track is set to final grade and alignment the contractor next places a compact cushion, 1-in. thick, of clean, dry, sharp sand. There is then poured by the contractor a concrete filling of the proportion of one part cement, four parts sand and nine parts broken stone or gravel. Care is taken that the consistency of the filler shall be such that the sand cushion under the ties shall not be saturated. After pouring, the filler has an all-over contact with the ties and rails, the upper surface of the filler being approximately 1-inch above the tie level. The final filling between the gauge lines consists of a one to one to two mixture.

In the 1913 construction no crown has been given to any part of the roadway. Between the rails the concrete is finished flush with the top of the rails. On each side the concrete is depressed ¼-inch below this level.

Special Work

All special track work is of 7-in. high T construction with tadpole type switches. All this work is of the guaranteed manganese insert type with the exception of one

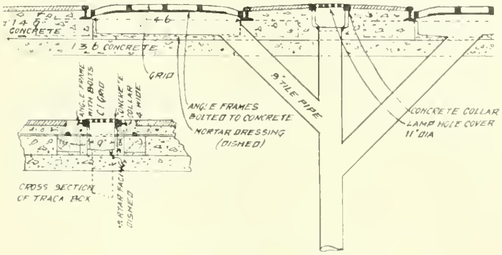


Fig. 2.—Track boxes on Edmonton System.

grand union which was furnished by Hadfields, Limited, and is of solid manganese steel. The other special track layouts were manufactured by the United States Steel Products Company and consist for the past year of:—2 three-part wyes with through crossings; 8 three-part wyes; 1 two part wye; 4 branch-offs; 1 single-track wye; 9 cross-overs; 2 45 deg. curves.

As will be seen from the foregoing the work is divided between the contractor to whom the work is awarded, and the city, as follows: the contractor is required to prepare (a) the grade; (b) the concrete base; (c) the sand cushion; (d) the concrete filler. The city supplies and leaves in place, to final grade and alignment, all track work which includes ties, rails, fasteners, bond work and overhead work. The contractor is paid for this class of work on the area basis.

At such points as are determined by the city engineer track boxes for drainage purposes are constructed according to the plan shown in Fig. 2. The contractor makes connections with the main sewer, constructs the track box and sets the cast iron grids to grade. This work is paid for at a unit price per box and a unit price per lineal foot of tile pipe installed.

The city constructs all pole work and overhead work prior to the skeleton track construction in order that power may be available for this work. In the case of centre pole construction the poles are erected after the subgrade has been prepared and before the concrete base has been constructed. The city undertake to do this work without undue inconvenience to the contractor and agree to sell power to the contractor for construction purposes.

Special provisions in the contract provide that all material must be so handled as not to obstruct the traffic.

The city of Port Arthur has just placed an order with the Ottawa Car Manufacturing Company for one single truck, double end p.a.y.e., double end control, street car and also an order with the Preston Car & Coach Company for three, double end, single truck, double end control, p.a.y.e. street cars. These cars are to be delivered in six weeks and seventy five days, respectively.

Illumination

Magnetite Arc Lighting in Lindsay

The city of Lindsay is one of the cities in the central part of Ontario served by one of the subsidiary companies of the Electric Power Company. It is located on the Scugog river, being on the Midland division of the Grand Trunk Railway and on the new line of the Canadian Pacific Railway to Port McNicol. In the past Lindsay received electric current from the old power house of the Light, Heat & Power Company of Lindsay which was located at Fenelon Falls. When the Light, Heat & Power Company of Lindsay was purchased by the interests controlling the Electric Power Company a new franchise was secured, and the latter company installed a transformer sub-station in the town, connecting it to the 14,000 volt transmission line of the Seymour Power & Electric Company. Arrangements were also made for switching and transformer equipment to be placed in the sub-station, so that it would be possible to parallel the Fenelon plant with the rest of the system. In this way absolute continuity of service was guaranteed to the citizens.

The main business street of Lindsay, viz.: Kent street, is one that the citizens are very proud of. It is 100 ft. wide building to building and 76 ft. wide curb to curb. During the past two or three years arrangements have been made with the Light, Heat & Power Company of Lindsay and with the Bell Telephone Company to have their poles removed from this street, and the only poles that remain standing on Kent street are those of the G. N. W. Telegraph Company, which it is hoped will soon be placed elsewhere. During the past

Kent St., Lindsay, by day—Note absence of wooden poles.

summer the city put down a permanent pavement on Kent street, which made this street far more valuable to the city and to the merchants, whose places of business are located here.

At the time of deciding to place a permanent pavement on this street a desire was also felt that a change in the lighting scheme should be made. Up to this time Kent street was lighted with suspended type enclosed carbon arc lamps, and before any decision was arrived at, the councillors made trips to other installations so as to be in a position to decide on the very best type of lighting for Kent street. After looking over different types of illumination it was decided that the ornamental type magnetite arc lamps would give the most satisfactory results for the street.

Kent St., Lindsay, by night—Almost like day.

The equipment that has been placed in Lindsay is fairly standard for this type of illumination. The station equipment consists of a 25-light constant current mercury arc rectifier, using a single tube, which is placed in the old sub-station of the Light, Heat & Power Company beside the constant current transformers used for the rest of the lighting system. The line leaves the sub-station overhead and about one half a block distant on William street enters an underground system, at which point it is protected by lightning arresters.

In deciding on the type of underground system that should be used in Lindsay it was first thought that steel armoured cable, protected by a creosoted board and buried in the earth, should be used, but as the sidewalk was to be extended over the place where the cable was to be laid, it was thought that this type of installation might cause future expense and trouble in ripping up the pavement and defacing the street, should a cable puncture at any time. It was hence decided to use 2 in. fibre duct placed in concrete, the requirements calling for 3 in. of concrete on all sides of the fibre duct, the cable used being lead covered and paper insulated, the insulation being for 3300 volts. The foundations for the standards were used as pull-in boxes.

The standards used were steel standards of the Luxolabra type, and were of such a height that they placed the arc 14 ft. 6 in. above the walk. The lamps used were ornamental type magnetite arc lamps, Form 10, 6.6 ampere, using an alba globe. In each case an absolute cut-out was placed in the


A Lindsay Standard.

base of the standard, making it possible to trim or adjust any lamp at any time with perfect safety.

In designing the layout of the lamps on the street it was decided to place the lamps 165 ft. apart on the same side of the street, staggering the lamps on opposite sides, and thus bringing one lamp every 82½ ft. of roadway. This was done, so that, for the present, efficient lighting would be obtained, leaving room so that at any time in the future it would be possible to double the illumination.

The effect of this layout has been such that there is, practically speaking, no glare encountered in the street. The color of the light is pure white, and it adds greatly to the attractiveness of the street as a business district. The general illumination of the roadway is such that it is possible to read a newspaper in any part of the street, but at the same time the light is not so strong that it is uncomfortable. The general effect of the installation has been to greatly improve the street, making it attractive and giving the lighting a dignified appearance. The three objects that were sought for in the lighting scheme were:

1st. To be able to easily discern objects on the street.

2nd. To be able to easily discern unevenness of street surface.

3rd. To obtain a white way illumination without a bizarre effect.

The system was put into operation at 7.30 in the evening of November 29th—the first installation of ornamental magnetite arc lamps in Ontario. No great trouble was encountered in putting the system into service, and it has been in nightly operation since that date. It is not yet possible to give any definite data with regard to the features of operation, as it has not been in service long enough.

Figure 1 shows a view of one standard unit. Figure 2 gives a day view of Kent street; note the conspicuous absence of wooden poles. Figure 3 gives a night view of the street from the first storey of a building at the end of it. Differences in illumination of the surface are plainly seen from the night view, but this is not noticeable by one walking on the street.

The lamps and station equipment for this installation were supplied by the Canadian General Electric Company, the standards by A. H. Winter Joyner Limited. The engineering and construction work was under the charge of the engineering department of the Electric Power Company.

Night Photography

A long felt want in the photographic business has been a system of illumination which would enable the photographer to produce as good results on dark days or after night as under conditions of clear day light. With the developments in illumination, progress has been made steadily in the desired direction and installations have lately been made by the Canadian General Electric Company which are claimed to give as satisfactory results during night time as at any other time in the twenty-four hours.

After considerable experimentation this company have built up a certain combination of different types of arc lamps which they manufacture for this purpose. These lamps are ranged in the form of an L and installed with the reflectors by the side of an enclosed white wall and suitably screened with prism glass and cheese cloth curtains have been found to give excellent results.

The light is of such a color that it is scarcely possible to notice any difference between it and daylight. This of course results in a total lack of eye strain and still the light is sufficiently intense on the plate and sufficiently rich in the necessary rays to produce a photograph with an exposure of the same duration as is given under the best daylight conditions in the same studio.

Quebec Water Powers

Two reports of the Quebec Streams Commission will be published during the present year. One of these deals with the studies of a general character carried out during the past year and the second will contain a review of the work done during 1913 in connection with the St. Maurice water storage proect. The aim of this commission is to improve the water powers of the province of Quebec by means of flow regulation and water conservation; also to encourage the development of the hydraulic resources in the province by private enterprise. The first report of the Commission, published November last, dealt with the conservation of water in a general way and also in a general way with the project for the storage of water on the St. Maurice River.

New Books

Handbook of Electrical Methods—McGraw-Hill Book Co., New York, publishers; price $3.00 net. This is a compilation of articles printed in the Electrical World from time to time during the last three or four years, of a type which relate purely to ways of doing things rather than of design, description of apparatus or of the commercial side of the electrical industry. It should therefore be of particular value to the practical man who is seeking that kind of information which is rarely obtainable from the average hand book. It is well illustrated and bound; 285 pages.

Personal

Mr. J. F. H. Wyse, consulting engineer, 34 Victoria St., Toronto, has been appointed organizer and engineer of the Ontario Safety League.

Mr. R. A. Lyons, for many years chief engineer of the London Electric Company, London, Ont., has resigned. The position will be filled by Mr. P. Wilkie.

Mr. Arthur Reid formerly superintendent of electric railways and electricity in Lethbridge, Alta., has been elected commissioner of public utilities for that city.

Mr. G. P. Cole addressed the Montreal Electrical Society on Monday, January 19, on the subject of transformers. At this meeting a resolution was adopted praying that the "City of Montreal employ resident engineers when engineering advice is required."

Mr. G. H. Stevens has resigned his position with the Toronto Railway Company to take up a position with the Canadian Niagara Power Company. Mr. Stevens will have charge of the entire secondary distribution system, etc., in the district of Fort Erie, Bridgeburg and Ridgeway and all work connected therewith, with headquarters at Fort Erie.

It has been decided to abandon the straight meter rate given in London by the municipal lighting commission up to the present time as an alternative. In future the universal charge for domestic lighting will be 1c per 100 sq. ft. plus 3c per kw.h. subject to a 25 per cent. discount. The commercial lighting and power rates have also been reduced considerably.

The Dealer and Contractor

Cost Calculation In Electrical Contracting

A paper containing valuable hints for the electrical contractor in general and especially for those of that calling who have not yet become habituated to the systematic conduct of their business was recently presented by Mr. Leo. Dolkart, Assoc. Mem. A.I.E.E., before a joint meeting of the Chicago section of that association with the electrical section of the Western Society of Engineers. The paper is valuable not only in that it discusses the essentials in the system of cost calculation, but in that a minimum of complicated calculations has been introduced. For this reason the ideas contained in the paper will be of value to the average electrical contractor who is not, for the most part, a very expert accountant. The paper follows:

"Hitherto it has been difficult to obtain data on costs and systems in contracting. This is especially true of the electrical contracting business. Contractors as a general rule are reticent in regard to the manner or method by which they arrive at their results. It is a fact, of course, that many contractors really have no method. The question with them is how close they can guess. At any rate there is a feeling among some contractors that if they happen to lose on one job the loss will be made up on the next one, since to them estimating represents a guessing contest. Of course, such contractors learn to their sorrow of the laws governing probability and chance. A feeling exists, too, that if one contractor devises some good system or an improvement in the method of doing business, there is a desire to "lie low"—to keep it from the "other fellow." It does not require much reasoning to see that such methods, as well as being out of date, are not productive of the best results. Co-operation and interchange of ideas between contractors will do much to uplift the profession and at the same time be of material benefit to the members thereof.

Estimating is, at its best, a very definite or indeterminate process, owing to the fact that so many variables make up the whole. Several of these, however, follow certain rules and may be more or less easily determined. In electrical contracting the material to be used on any particular job can be estimated to within a small percentage of that actually required. With the labor, it is an entirely different matter. Some of the variables to be considered in estimating the labor on any particular job are:

Season of the year the job is to be installed.

Rapidity of work of wireman A.

Rapidity of work of wireman B.

Rapidity of work of wiremen A and B when working together.

Section of state or country where job is to be installed.

It is hardly necessary to call attention to the fact that some work can be done more rapidly in cool weather than in warm weather, and vice versa. It is also true that if wiremen A and B are put to work together on one job, the net result will more often be less than the sum of the net results of both A and B, were the two working separately. The net result may be also very different from that obtained by putting A and C or B and C together. The most economical combination can be determined only by trial.

That the section of the country where the job is being installed bears a certain relation to the rapidity with which the work will be completed is too self-evident a fact to need further elucidation.

One would at first imagine that with all these different items determined upon and the total material and labor estimated, it is an easy matter to arrive at the total cost of the job. Adding to the total the per cent. of profit would or should give the total amount of the bid. For illustration we will suppose a job X:

Material cost	$150.00
Labor cost	100.00
Total	$250.00
15 per cent. profit	37.50
Bid	$287.50

From the above it would appear that the job should net a very satisfactory profit of $37.50. Many contractors actually assume that $250 represents their actual cost on the above job. Really, however, such a cost system does not represent the true and accurate state of affairs. Expenses such as rent, telephone, light and power, office help, freight, etc., have not been considered. All such expenses coincident to the pursuit of the business make up what is termed the overhead expense.

It has been the practice, hitherto, of contractors taking care of the overhead to obtain the total overhead expense for the year, and, by dividing this sum by the total amount of business done during the year, obtain what is termed the percentage of overhead. That is, if the total amount of business for the year was $40,000, and the expenses for the year amounted to $8,000, the overhead would be 20 per cent. At first glance this would appear rather large for this amount of business, but actual facts as compiled from information supplied by contractors throughout the United States prove this percentage to be very low. As a matter of fact, for this amount of business it would be nearer 22 per cent. The percentage of overhead bears an inverse ratio to the amount of business done, and for a total year's business of less than $1,000 it amounts to about 45 per cent.

Taking the same example as considered in job X and applying the above rules, the cost would be as follows:

Material cost	$150.00
Labor cost	100.00
Total	$250.00
20 per cent. overhead	50.00
Actual cost	$300.00
15 per cent. profit	45.00
Bid	$345.00

It will be readily seen from the above that had the con-

tractor taken the job for $287.50 he would not only not make any profit but would be an actual loser of about $12.50.

It is, of course, self-evident that the first method of figuring is entirely wrong. It is surprising that so many contractors do actually pursue such antiquated methods and are wondering why business seems to be unprofitable.

It is the aim of this article to prove that even the second method of figuring is wrong, in that the manner of obtaining the overhead expense is not strictly in accordance with the actual state of affairs. This can be readily seen from the following illustrations. Take two jobs whose total costs equal the same but with varying labor and material items:

Job A.		Job B.	
Material cost ...	$100.00	Material cost ...	$150.00
Labor cost	150.00	Labor cost	100.00
Total	$250.00	Total	$250.00

It is evident, of course, that job A will take one and a half times as long to complete as job B, but will, with the ordinary method of figuring, bear exactly the same percentage of overhead.

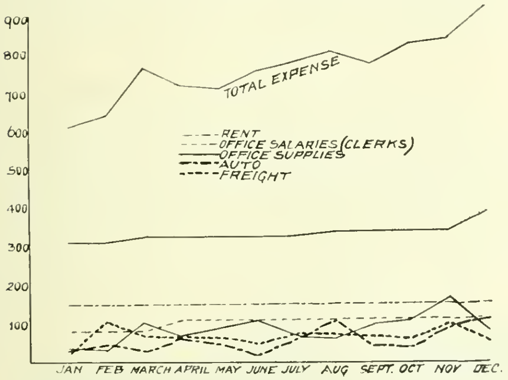


Fig. 1

If one stops to consider the components that comprise the "total overhead expense" one can readily see that most of these elements, rent, salary, telephone, insurance, etc., bear a certain relation to time. It is self-evident, therefore, that the total sum of these should also be proportional to time. In other words, if job A took one and a half months to complete, it would cost the contractor just one and a half times as much in labor overhead expense as job B, which took only one month to complete. Consequently overhead expense being proportional to the time element is proportional to the amount of labor, conveniently called "man hours."

It is apparent also that the cost of handling a job that takes a good deal of material is more than one that takes less material. It would appear, therefore, that in order to be just to the material and labor items, it would be necessary to divide the total overhead expense into two separate parts, one proportional to labor and the other to material. This the writer has applied to actual work and found to be very satisfactory.

The cost of doing business per "man hour" can be easily determined. In order to do this it is necessary to divide the total cost of doing business into two sets of expenses as shown below:

By dividing the total labor expense for the year by the total amount of labor hours, the overhead per "man hour" can be easily obtained. Dividing the total material expense for the year by the total amount of material handled will give the percentage of overhead for material.

Labor Expense	Material Expense.
Office rent.	Store room rent.
Office salaries.	Stock clerk's salary.
Telephone and telegraph	Freight and hauling.
Light and power.	Fire and insurance.
Liability insurance.	Stock room supplies.
Office supplies.	Depreciation of furniture.
Depreciation of furniture.	Maintenance of wagon.
Depreciation of tools.	Depreciation of wagon.
Maintenance of automobile.	
Depreciation of automobile.	

Referring back to our two jobs and correcting the overhead we will find the following net results:

Job A.		Job B.	
Material cost ...	$100.00	Material cost ...	.$150.00
Material overhead, 5 per cent.	5.00	Material overhead, 5 per cent.	7.50
Labor cost, 300 hrs.	150.00	Labor cost, 200 hrs.	100.00
Labor overhead, 25c	75.00	Labor overhead, 25c	50.00
Total cost	$330.00	Total cost	$307.50
15 per cent, profit .	49.50	15 per cent profit .	46.13
Bid	$379.50	Bid	$353.63

Comparing these figures with our previous computations, it will be readily seen that if job A were taken for $345.00 it would not have proven very profitable. On job B the profit would be slightly greater than the original bid allowed.

The division of the overhead expenses as outlined above takes care of practically all expenses incidental to this line of business. There may be two or three items which it may be deemed advisable to also include in the overhead, such as taxes, advertising, and bad accounts. The latter, particularly, should be such a small item with an electrical contracting business that it may be best to charge it to the profit and

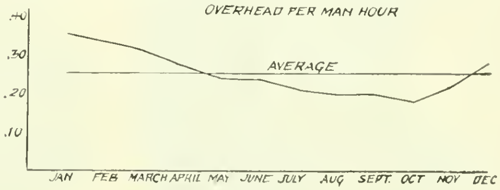


Fig. 2

loss column. In some localities the item of advertising may call for very heavy expenditures. In such cases the total expense should be divided and the material and labor expenses be made to take the pro rata shares.

Both the labor and material expenses may be readily shown graphically month by month. The writer finds it very convenient to plot these expense curves for reference. At a glance these will indicate the "pulse" of the business, for with an increase of business the overhead falls, and rises again with a slump in the business.

The curves in Figs. 1 and 2 illustrate graphically some of the expenses previously indicated. Fig. 1 shows some of the larger expenses. It may be desirable to combine the two expenses indicated by the general office salaries and clerks' salaries. In this particular instance, however, it was thought advisable to keep the clerks' salaries separate from those of the officers of the company and the engineer. Fig. 2 shows the overhead per man-hour curve and one drawn to indicate the general average for the entire year. One can at once see how the cost per man-hour decreases with the increase in the amount of business done. This, of course, bears out actual conditions when work is plentiful in the summer and fall months. With a decrease in business the

overhead increases, due to the fact that the actual expenses are not proportional to the amount of exact business transacted. That is, if during the summer months the business increases 100 per cent. over that done during the winter, the expense of doing business will not fall in the same ratio. Actual facts bear out this statement since the expenses month by month for any particular business do not greatly vary.

It is convenient, for record, to plot each expense month by month. At the end of the year a study of these will be of material assistance to any business in deciding upon policies to be pursued for the ensuing year."

A Practical Non-Registering Fare Box

The accompanying illustration shows an exterior view of a fare box that is manufactured by the Cleveland Fare Box Company, of Cleveland, Ohio. This box embodies an original style of locking mechanism combined with light yet durable construction. The cabinet, cash box and doors are of 1/8-in. cast aluminum and all working parts are of manganese bronze. It can be attached to the railing on the platform and can be arranged to operate either portable or stationary.

One of the construction features of the cabinet is found in the design of the corner posts which support the glass surrounding the inspection chamber. These corner posts are of cast aluminum with 3-16-in. cold rolled-steel tie rods, which hold the top casting to the lid of the fare box, applied on the inside of the corner-post angle. The tie rods screw into the top casting and are attached to the cover with jam nuts on the under side.

The inspection chamber has three saw-toothed baffles, so arranged as to make it impossible to remove cash or tickets. All fastenings are on the inside of the cabinet, making it im-

A practical fare-box

possible to take the box apart without destroying it or unlocking the cabinet door and removing the cash box. The spout and cabinet cover are cast in one piece and bolt to lugs on the inside of the cabinet, so that the whole construction is very strong and durable. The door of the cabinet is provided with a Yale or Corbin lock, and has a lug cast on the hinged side which prevents the door being removed even though the hinge pin should be taken out.

The cash box cannot be inserted in the cabinet until it has been unlocked, and it cannot be removed without locking itself. The bottom and sides of the cash box are cast in one piece and the top, to which the lid is attached, is rivetted to the upper portion of the box. The lid or door to the cash box has a special spring lock with a safety device attached, which makes it impossible to remove the cash box from the cabinet unless it is properly locked. This special lock is manufactured by both the Yale & Towne and the Corbin Lock Company, on specifications furnished by the Cleveland Fare Box Company, and no one can purchase this lock or a key to the same without permission from the fare box company. Guide grooves are cast in the sides of the cabinet for the support of the cash box, and lugs on the cover of the cash box must pass through ratchet wheels provided with dogs, which makes it impossible for the cash box lid to return in the same grooves it was inserted in.

This box was designed with the intention of keeping the key to the cash box in the counting room and the key to the cabinet in the hands of the car-house man who is delegated to remove the cash boxes from the cars. The cash boxes can be numbered and the number will be exposed through an opening in the cabinet, so the conductor can place the number of the cash box he is working on on his trip sheet the same as he does the number of the car.

The fares are placed in the box in the ordinary way by the passengers, the coin or tickets resting on the hopper door of the inspection chamber so the conductor can see that no mutilated or counterfeit coins or tickets are deposited. By means of a small lever the conductor controls the dropping of the fares into the cash box.

Exclusive Canadian Distributors

The firm of C. H. Basters & Company, who have offices and store rooms at 22 College street, Toronto, are exclusive Canadian distributors for an efficient line of Holland and German general electrical supplies, including the now well-known Condor lamp which has been on the market some 12 months and, according to reports, has given entire satisfaction. This business has grown very rapidly during the past year and the firm now have a number of travellers covering the Canadian field regularly.

In addition to the Condor lamp, which is their specialty, this firm have a varied display of electrical household supplies and novelties, including electric irons, water heaters, fans, stoves, fixtures, and the smaller kinds of fittings. Four types of iron are carried: a travellers' outfit, consuming 250 watts; a 6 lb. iron, 321 watts; an eight lb. iron, 400 watts; and a 10 lb. iron, 500 watts, the two latter being supplied with snap switch in the handle. Another interesting line is a bed warmer, to take the place of the hot water bottle, which consumes only 40 watts per hour. Among the other purely household equipments might be mentioned a Dutch brass teapot, quart size, consuming 500 watts; a 2 quart tea kettle consuming 500 watts and a saucepan with egg boiler attachment, 1 quart and 2 quart size consuming 380 and 500 watts.

Fans of various sizes are also carried, including an oscillating type specially worthy of notice in that the mechanism is all entirely enclosed within the motor frame. Another useful type is their adjustable fan which may be adjusted to any position and may be attached to the table, wall or ceiling.

This firm's list of lighting fixtures includes a number of Dutch designs which are very handsome, especially one in carved Carrara marble. Their lighting fixture line includes a trouble lamp with patent switch in the handle and of waterproof construction; also numerous types of desk and portable lamps and a lamp replacer of very simple design and low cost for removing and replacing broken lamps. Electric stoves of the luminous type and also of the type using quartz tubes, will be carried in stock.

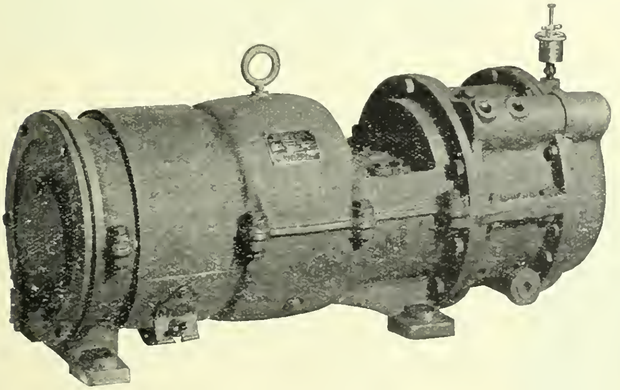
Decidedly the newest feature in this firm's equipment is their "reflector" lamp. Quite recently there was placed on the Canadian market a lamp with a self contained reflector, the reflecting material being placed on the inside of the upper part of the lamp. The new reflecting lamp carried by

the Basters Company differs in that the reflector is a separate part which fits over the base half of the lamp, the lamp and reflector being so carefully constructed that when assembled they appear as one unit. This lamp is protected by patents in Canada.

Among the novelties might be mentioned a flash lamp which combines a number of uses. This unit may be used as an instantaneous flash light or as a continuous source of light. It is also supplied with a 5 ft. cord at the end of which is a control switch enabling the lamp to be operated from a distance; this is an especially valuable feature for illuminating a clock or watch face in the night; the equipment includes a stand for the watch and also for the lamp so that these may be set in their proper relative positions on a table or chair near the bed and the cord placed with the switch end under the pillow or in some other convenient position. Another feature is the interchangeability of the push switch and the lamp unit so that the lamp may be placed on the end of the cord and the push switch attached to the battery and thus making a convenient "trouble" lamp. A fifth feature is its use in photographic work by covering the lamp with a small colored glass hood which fits on snugly.

A One-Kilowatt Turbo-Generator Lighting Unit

Light is frequently wanted for limited areas where steam is available but suitable electric power is not, as on contracting operations, small industrial plants, steam launches, etc. To provide a means for supplying electric light under such circumstances, the Westinghouse Electric & Mfg. Company have recently put on the market a small turbo-generator which will operate an arc lamp and a few incandescents at the same time, or about forty 25-watt mazda lamps, or their equivalent, alone. This unit is very compact, being only 3 feet long and 1½ feet high, and can be installed anywhere provided the unit is kept horizontal. It requires practically no attention when operating; there are no delicate adjustments to make; and all parts are easily accessible. The turbine and generator are mounted in the same frame. The turbine is of the impulse type and has a governor which keeps the speed uniform for all variations of load and steam pressure. The full rating of one kilowatt will be developed on 90 pounds steam pressure, and satisfactory operation can be obtained with pressures up to 250 pounds. The weight is 283 pounds. The rated voltage of the generator is 120 volts.



1 kw. steam turbo-generator

A New Vibrator

The Hamilton-Beach Manufacturing Company of Racine, Wis., through their Canadian agents R. E. T. Pringle are placing on the Canadian market a new type of electric vibrator to which they have given the name Try-New-Life. This equipment is manufactured in three types, two of which are illustrated herewith. The type shown in Fig. 1 is designed specially for home and family use. It is equipped with a 1/30 h.p. motor and is supplied with insulated cord and current tap for attaching to any electric light socket. Type B shown in Fig. 2 is identically the same machine as type A except that it is wound to operate on dry batteries instead of on the electric light current. This is meant for family use in homes where electric light is not available. Type C is a larger and stronger machine and is generally preferred by medical men. It is fitted with a 1/20 h.p. motor.

Fig. 1

Fig. 2

The following rural telephone companies have been newly incorporated: Kindred Rural Telephone Company, Limited, Holdfast, Sask.; South Bethune Rural Telephone Company, Limited, Bethune, Sask.; Bethune South-West Rural Telephone Company, Limited, Bethune, Sask.; Sunnyside Rural Telephone Company, Limited, Normanton, Sask.; Grimes Rural Telephone Company, Limited, Lampman, Sask.; Duval & Dunkeld Rural Telephone Company, Limited,

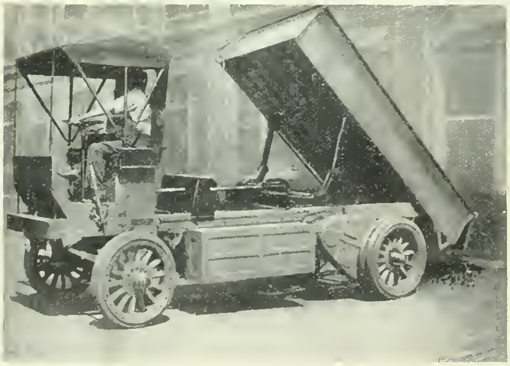
Record Mine Operations

Eighteen 100,000 pounds capacity steel railroad cars, loaded in a single day, is the record output recently made by one motorman at Mine No. 1 of the Scalp Level Coal Mining Company, whose offices are at Windber, Pa. This mine is one of the John Lochrie operations and is situated in the famous Windber coal field. On this particular day they worked exactly nine hours and forty-five minutes. The only haulage equipment used was an eight-ton Baldwin-Westinghouse barsteel electric mine locomotive, equipped with commutating-pole motors. This locomotive, except for a few mine cars hauled from a dip from a point in the heading by a mule, did all the work, gathering the coal cars and hauling them to the tipple. The cost of operating this locomotive for the day was: motorman, \$3.30 and spragger, \$2.90, making in all \$6.20.

Twelve mine cars, each loaded with two tons of coal, were hauled on each trip. The longest haul was made about 2,500 feet from the face of the first to tipple and about the same distance from face of main heading to tipple. The grades in this mine at the two points for a distance of 400 feet are $1\frac{1}{2}$ per cent. against the loads. Thirty-six trips were hauled, and it is estimated that at least two minutes were lost on each trip on account of the motorman waiting for empty cars outside. Notwithstanding this loss of time the operators feel certain this was the highest run of coal ever made in Western Pennsylvania in one day by one motorman, and it is believed that it has never been equalled elsewhere.

Four-Ton Electric Dumping Truck

A new 4-ton electric dumping truck has just been placed on the market by The Baker Motor Vehicle Company of Cleveland. The dumping body is made of sheet steel reinforced with angle iron and is well riveted together. The floor is made of channel steel riveted together, with a smooth steel plate on top for floor. The tail gate is locked and unlocked by a lever at the side of the driver's seat. The body can be tipped to an angle of 45 degrees. The tipping is done by two arms, one on each side of the body, fastened to a large steel crank shaft which revolves in one direction only, two-thirds of the revolution to tip and one-third to lower. This allows the body to come down to its position on the chassis frame in half the time required to raise it for dumping. The body may be raised and lowered to its regular position in 50 seconds.



Electric dumping truck.

The dumping is done by either a hand crank or an auxiliary motor mounted under the seat and driving through a shaft and worm 8 spur gear reduction on the crankshaft. This shaft runs in oil contained in a dust-proof housing.

New Pole Line Hardware

Hubbard & Company announce the addition of a forged steel high tension pin to their line of pole line hardware. This pin was developed to overcome the inherent defects of the old types of malleable and cast iron supports for high tension insulators, and is claimed to be by far the lightest, strongest and cheapest pin of the center bolt separable thimble type on the market. The strength of all other separable thimble pins is limited to the bending strength of the centre bolt at the point of contact between the thimble and the main casting, and the diameter of this bolt is in turn limited to $\frac{3}{4}$-in. by the fact that the bolt must be small enough to screw into a cast thimble of not over $1\frac{1}{8}$-in. outside diameter, in order to permit cementing into a $1\frac{3}{8}$-in. pin hole. In the new forged steel pin the tapered collar of the thimble, which is of malleable iron, greatly reinforces the pin at its smallest diameter, thus allowing the use of the standard type of thimble without any reduction in the strength of the pin. When a stress is applied to a pin having a long center bolt, the bolt will stretch considerably, allowing a deflection, which in one case amounted to $5\frac{1}{2}$-in. under a horizontal pull of 1750 lb., while a forged steel pin subjected to an equal stress deflected only $\frac{1}{4}$ in.

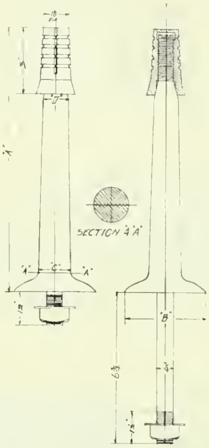


Fig. 1

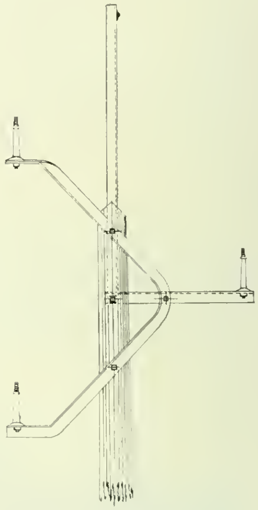


Fig. 2

The new forged steel pin is made in two styles, shown in Fig. 1, the long shank pin, for use with wood or channel steel arms, and a short shank type for use on arms of angle section, including the "Bo-Arrow" arm and high tension extension, Fig. 2. There are no welded joints in this pin, as it is forged from a solid bar of open hearth steel, insuring freedom from flaws. It can be furnished plain or galvanized to meet the N.E.L.A. test in different sizes. Its light weight, coupled with the fact that there is only one part to handle, will effect a marked saving in construction costs.

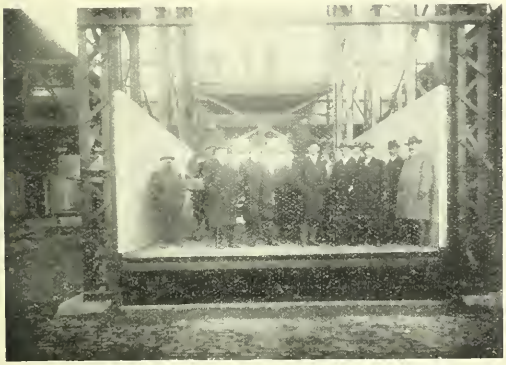
The malleable thimble used with the forged steel pin is also used with the high tension channel steel clamp pin for wooden and angle steel arms, and with the various types of pole top pins manufactured by this company. All of these pins, together with the Peirce cone type sheet steel pin, are described in the Hubbard Reference Book of Transmission

Line Construction, which is now ready for distribution, having been held up from time to time for the inclusion of new matter.

New 15-ton Electric Elevator

The Montreal Harbour Commissioners have just added another electric hoist to their equipment, making a total of three. The hoist is situated in the centre of a pier, with warehouses on either side, and is used for conveying freight and teams to and from the upper storeys of the sheds. It has a lifting capacity of 30,000 pounds, with a constant speed of 30 feet per minute under all conditions.

The hoist, supplied by Darling Bros., Limited, of Montreal, is constructed of a steel frame with diagonal bracings, covered with corrugated iron sheeting and a final covering of asbestos. The elevator platform is 30 feet long by 16 wide. On the ground floor level there is an opening to give



Another electric hoist for Montreal Harbour.

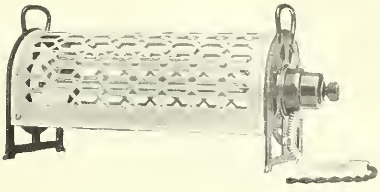
access for the teams to the platform, and on the upper level a corresponding opening to allow teams to drive into the warehouses.

The electric current is supplied from No. 1 station and is a.c., 3-phase, 63 cycle, 550 volt. The motor is 52 h.p. of the C. G. E. slip-ring type. The resistance in the secondary circuit is automatically cut out as the motor starts, thus allowing the motor to develop a high starting torque with low consumption of starting current. The motor control mechanism is operated by an automatic a.c. reversing motor controller, which controls all operations of the motor and the elevator. All circuits to the motor are opened when the motor is stopped. There are no voltage and over-load release coils, this safety device preventing any accident should the power go off or the fuses fail at any period.

A New Type Luminous Heater

A new type of luminous electric heater has just been placed on the Canadian market which utilizes quartz tubes instead of glass globes as in other luminous radiators. This is called the Bastian heater and has been placed on the Canadian market by the Masco Company, Limited. The heating elements or glowers used in this heater are simply open-ended glowers with a spiral of nichrome alloy or other suitable heating wire extending through the tube, and terminating in a smooth plug at each end. Each quartz tube is therefore an independent glower unit which is fixed into the heater by means of a pair of spring clips. A unit is thus easily removed and replaced. In the smallest type of heater there are six of these tubes with 12 and 24 in the larger types.

Quartz possesses many advantages over glass in that it is not only transparent, but, it absorbs very little heat, allowing the heat to radiate through it with practically no loss. Quartz has a very high melting point and cannot be fused at normal temperatures. It has been maintained at a red heat in the atmosphere for a whole year without indicating any apparent chemical or physical change. It can even be



Quartz type Luminous heater.

plunged into ice-cold water when red hot without cracking the quartz, so that a spray of water falling on the heater by accident will not impair it in any way.

It will thus be seen that this type of heater is very permanent in its character as the life of the quartz tube is practically unlimited and the wire spiral is all that would require to be replaced. Under normal conditions the wires are guaranteed by the makers for four years, and in this connection we are given to understand that the Westminster Electrical Testing Laboratories report that they have tested out a stock heater, type A, 250 watts, on an unregulated commercial circuit for 4,000 hours at the expiration of which time there had been no failures of any kind nor any sign of failures.

In ascertaining the requirements of the average room the manufacturers claim that 1 watt per cubic foot of space can be depended upon to raise the temperature 30 deg. Fahr.

Mainer Electric Company

Such a satisfactory statement of 1913 business was presented at the annual meeting of the Mainer Electric Company of Winnipeg, held on January 10, 1914, that the directors decided to immediately apply for power to raise the capitalization of the company to $500,000. This company has been in business eighteen months and during that time has succeeded in annexting a very generous share of the electrical supply trade in Western Canada. Plans for considerable increase in the scope of the company have been decided upon and very shortly two branch houses will be established. An auto truck delivery service will handle the city of Winnipeg business for the future. Mr. R. H. Mainer was again elected vice-president and general manager.

Announcement

Supplementary to the advertisement which appeared in the January 1 issue of the Electrical News the Swedish General Electric Limited, are distributing folders announcing that the business which has heretofore been carried on under the name of Kilmer, Pullen & Burnham, Limited, will in future be conducted under the name of the Swedish General Electric, Limited. The head office will be, as formerly, in the Kent Building, Toronto. Mr. Frank Pullen, the president of the company, states that this change of name has been adopted as conveying to the public a better idea of the business they are conducting, namely the supply of Swedish General Electric generators, motors and electrical installations of all kinds.

The receipts of the Nelson Street Railway System for 1913 were $13,857 as compared with $13,070 for the previous year. After February 1 the system will be operated by the municipality.

New Electric Firm in Ottawa

A new electric contracting firm, the Mac Electric Company, has started up in Ottawa, Ont., under the general managership of Mr. W. McInenly. The new company will carry a very complete line of all kinds of electrical apparatus and supplies. They will also specialize on electric elevators and at the present time are installing one in the Lavel building for Darling Bros. Co. It is said the new company maintain the largest repair shops in the city of Ottawa and are fully supplied with competent workmen in charge. Mr. McInenly is a nephew of Mr. T. Ahearn.

Two New Applications of Magnetic Separators

Removing iron particles from ground scrap rubber in the reclamation plant of a rubber mill and extracting the metallic iron from crushed slag in the steel plant are two new applications of Cutler-Hammer magnetic separators that have recently been made. The separating is effected on a belt over the magnetized pulley wh'ch picks out the metallic particles and allows the balance to be cast forward to a conveyor or chute.

Contracts have been awarded by the Kaministiquia Power Company in connection with extensions to their hydro-electric plant at Kakabeka Falls as follows: 850 feet of 11 ft. diameter steel penstock to the John Inglis Co.; one double runner 15,000 h.p. 257 r.p.m., twin spiral closed turbine and accessories to the Voith Company, and one 12,000 h.p., 3-phase, 4400 volt generator, together with all switchboard apparatus, cables and appurtenances, including five 1500 kv.a. transformers to the Canadian General Electric Company. Mr. R. S. Kelsch is consulting engineer for the company.

New Companies

Hilton Electric Company, Limited, capital $50,000, head office, Montreal.

A. B. See Electric Elevator Company of Canada, Limited, capital $100,000, head office Montreal.

The Ganges Water & Power Company, Limited, has been incorporated with head office at Ganges, B.C.

The Canadian Hot Point Electric Heating Company, Limited, has been incorporated with capital $100,000 and head office Toronto.

The Flour City Ornamental Iron Works, Limited, has been registered, with head office Vancouver, and capital $500,000. Among other products this company will manufacture ornamental lighting poles.

The Winnipeg River Power Company, Limited, have been incorporated. It is understood the object of this company is to develop power on the Winnipeg River which will be supplied to the Winnipeg Electric Railway Company.

The Stamp Falls Power Company have been incorporated. Among the objects of the company are stated to be the acquirement of the rights of the Ritchie Agnew Power Company and the interests of the British Columbia Hydraulic Power Company on the Nanaimo River and in the city of Nanaimo.

The Northern Electric and Manufacturing Company, Limited, of Montreal, has been re-incorporated with a capital of $10,000,000, under the name of the Northern Electric Company, Limited. The Standard Underground Cable of Canada, Limited, has increased its capital from $500,000 to $1,000,000, and the Kaministiquia Power Company, Limited, from $2,000,000 to $2,500,000.

Trade Publications

Wiring Devices—Bulletin No. 835, issued by Pass & Seymour, Incorporated, illustrating fully and describing, with prices, their handy electrical wiring dev'ces.

"Standard" Fans—Catalogue No 10 issued by Robbins & Meyers of Springfield, Ohio, describing their various forms of ceiling desk, oscillating and exhaust fans for d.c. and a.c. circuits.

Mill Type Motors—Bulletin No. A4064 issued by the Power & Mining Department of the Canadian General Electric Company describing and illustrating fully this company's special motors for mill work.

Car Equipment—The Electric Service Supplies Company have issued a leaflet illustrating their F & P car replacer and St. Louis trolley pick-ups. Both of these are urged as being profitable equipment for every car.

Heating and Ventilation—Catalogue No. 215 issued by the B. F. Sturtevant Company, Boston, Mass. This is practically a treatise on the subjects of heating and ventilation being bound in book form and containing over 300 pages of useful information.

Lamp Guards—The Electric Service Supplies Company have issued an attractive folder describing and illustrating their Keystone Lamp Guards. An effective illustration shows clearly every detail in the construction of their portable type. A conduit box type is also shown and listed.

Block Signals—Bulletin 126, issued by the General Railway Signal Company, describing very completely their system of alternating current block signals as installed on the Southern Railway. The description is written by Mr. W. J. Eck, signal and electrical engineer of the Southern Railway Company, and explains and illustrates the system very fully.

Westinghouse Publications—The Westinghouse Electric & Mfg. Co. have issued the following booklets:—Motor Driven Refrigerating and Ice Making Machinery; Baldwin-Westinghouse Electric Mine Locomotives; and Westinghouse Portable Meters. These publications are splendidly illustrated and describe the various equipment very thoroughly.

Battery Truck Cranes—A descriptive booklet issued by the General Vehicle Company, Inc., Long Island City, New York, describing the G. V. battery truck crane. The booklet is well illustrated and gives some interesting facts on the variety of work this crane will perform, with cost figures. The same company have also issued No. 1 of Vol. 1 of the Central Station Bulletin which presumably will appear monthly in future.

Evershed's Instruments—A descriptive catalogue issued by Evershed & Vignoles, Limited, London, Eng., through their Canadian agent R. H. Nichols, Dineen Building, Toronto, describing the measuring instruments and other apparatus manufactured by this firm. The catalogue is very completely illustrated and descriptive including ammeters and voltmeters, leakage instruments, resistance testing sets, water testers, capacity meters, pyrometers, speed indicators, etc.

Automobile Lighting—A little booklet issued by the Holtzer-Cabot Electric Company of Brookline, Mass., describing their magneto generator for automobile lighting and battery charging. This magneto has an output of 5½ amperes at 6½ volts and while not of sufficient capacity to supply all the electrical requirements of the largest cars is claimed to be large enough to meet the needs of the majority of cases. The booklet illustrates and fully describes the construction and operation of the system.

Current News and Notes

Arthur, Ont.

The Commercial Hotel have installed a small isolated electric generating plant driven by a gasoline engine.

Brantford, Ont.

The streets were illuminated in part on January 19 with the new magnetite arc lamps. It is expected that the complete system will be in operation by February 1.

The water commissioners have decided to close a contract with the Ontario Hydro-electric Commission for the supply of power to operate the waterworks pumps.

The local hydro-electric commission have decided to open a store for the demonstration, display and sale of electrical equipment, this store to be situated on one of the main business streets.

Brandon, Man.

Superintendent Antonisen of the municipal railway system will prepare and submit estimates of the cost of laying extensions to the street railway system.

Superintendent Antonisen has issued a report on the operations of the municipal electric railway system for the seven months of 1913 during which the line was operating. The report states that the average daily receipts were $143.84 and the average daily operating expenses $141.81. Operating expense does not include any sinking fund allowance, but for the short time the line has been in operation this may be considered a very satisfactory showing.

The 200 delegates of the Manitoba Growers' Association which met here on January 7 discussed among other things the hydro-electric power proposition. It appeared to be the general desire of the delegates to have the government do something in the way of establishing a distribution system along somewhat similar lines to that now in operation in Ontario.

Bellisle, P.Q.

The town of Bellisle, P.Q., are installing a system of electric lighting.

Chilliwack, B.C.

The town has entered into a ten-year contract with the B. C. E. R. Co. The company will install 100 candle power tungsten lamps on the streets and maintain them for $18 a year up to one o'clock a.m. each night and for $27 per year if an all night service is given.

Coaticook, Que.

The annual statement of the electric light department for the year 1913 shows a balance net profit of $1,611.

Creemore, Ont.

By-law has been passed by large majority for use of hydro power.

Calgary, Alta.

Tenders are called by the Department of Public Works, Ottawa, for three passenger and one freight elevator for the Calgary examining warehouse. Electrical equipment for these elevators is included in the tenders.

A report was recently published in the press that the city of Calgary was thinking seriously of developing one or more water powers in the neighborhood of that city, but we understand there is little likelihood of any movement in this direction under the present conditions. Before any large quantity of reliable power can be developed in that neighborhood a tremendous amount of money would be required to construct storage reservoirs in the mountains. The Bow River, for example, is very uneven in its flow, as is shown by the fact that the Calgary Power Company have a storage located at Banff which they use to advantage. The irregularity of the flow at the different seasons has been a determining factor in the recent action of the city of Calgary in building and maintaining a large steam plant to take care of the winter load. Until such time as money is available from the government or other source for the construction of a complete system of storage reservoirs it is therefore quite unlikely that this city will do anything towards developing any hydro-electric plant of their own.

Duncan, B.C.

It has been learned that the civic authorities of Duncan (Vancouver Island) have decided to delay the establishment of the proposed hydro-electric plant there for at least another year on account of the prevailing dullness in financial circles. An oil engine reserve plant of probably 200 kw. will be installed in the meantime, work in connection therewith being scheduled to commence without delay under the supervision of DuCane, Dutcher & Company, Vancouver, the consulting engineers for the city.

Embro, Ont.

It is probable a by-law will be submitted in this village in the near future regarding the installation of Niagara power.

Fort Frances, Ont.

At the recent annual meeting of the Board of Control of Fort Frances a large number of citizens were present from the International Falls, the town just across the river on the U. S. side, and discussed informally the prospect of recent electric power from Fort Frances to be developed at one or more points in the neighborhood of Fort Frances. It is understood the matter will be taken up with the Hydro-electric Power Commission of Ontario both as to the development of power and its export.

Fort William, Ont.

A report was recently made to the city council on the question of purchasing the entire system of the Mount McKay and Kakabeka Falls Railway Company to be operated as part of the municipal electric railway system. The city railway committee of Fort William will consider the matter.

The matter of connecting Fort William with Winnipeg by long distance telephone will be taken up with the Ontario and Winnipeg governments with a view to getting them to finance the scheme.

Guelph, Ont.

The Guelph Railway Company have awarded contract for two new cars to the Preston Car & Coach Company.

Hamilton, Ont.

A recent report on the laying of conduit in Hamilton showed that work to the extent of approximately $100,000 had been completed.

The Hamilton Street Railway Company have inaugurated

a new rule by which their conductors are required to remain on the rear of their cars. It is said that since this rule has been in effect there has been a noticeable decrease in the number of accidents.

The Standard Underground Cable Company are considering factory improvements and extensions.

In connection with the new steam plant to be built by the Dominion Power & Transmission Company it is announced that contracts have been awarded to the Canadian Westinghouse Company for the initial electrical equipment;

Huntsville, Ont.

The newly elected council of Huntsville are taking up the question of further power development.

Harriston, Ont.

An all-night service will be given in this town in future, it having been decided that the extra cost is small in comparison with the advantages and conveniences to be derived from a more extended service.

Kelowna, B.C.

Active operations are planned for the coming spring or early summer in connection with the Belgo-Canadian Land Company's hydro-electric project at Mission Creek, 15 miles from Kelowna, in the Okanagan Valley. It is proposed to develop 2,000 h.p. at this point, and to transmit power into the city over the main transmission line at 13,000 volts. The company expects to dispose of its power to consumers in the adjoining district as well as in the city itself, the intention being to erect branch lines at different points along the main route. The final survey in connection with the project has been completed and plans were filed recently with the Belgo-Canadian Land Company by DuCane, Dutcher & Company, Vancouver, consulting engineers for the work.

Lake Megantic, Que.

New tenders to be called in a few weeks for the construction of the dam in connection with the municipal plant. First tenders were unsatisfactory.

Longueuil, P.Q.

The Armstrong Whitworth Company of Canada, who are building an extensive plant at Longueuil, P.Q., on the south shore of the St. Lawrence, propose to put in an installation for running the machinery by electricity and for lighting the works. The current will be supplied by the Montreal Light, Heat & Power Company at 22,500 volts, which will be transformed to 2200 volts. The equipment will include a synchronous motor connection up to a three-wire 500 volt, d.c. generator, and there will also be a large rolling mill motor. The current for lighting purposes will be transformed to 100 volts, flaming arc and tungsten lamps being used.

Lethbridge, Alta.

Tenders are received until February 9th for the installation in a public building, of an electric passenger elevator, to include the necessary electrical equipment.

London, Ont.

It is reported that the London Street Railway Company will purchase air brake equipment for a number of their cars.

The by-law which carried last year requiring the separation of the hydro-electric and the water department was repealed at the recent elections and these two departments will in future be under the same head.

Rapid increase in the demands on the electrical department will require an early extension of the transforming stations in London. This necessity has been emphasized by the recent contract with the London Street Railway which will eventually require approximately 1,000 h.p.

Markdale, Ont.

The Hydro-electric Power Commission have submitted a rate of $24.36 for power at this point when the Eugena Falls plant shall be completed.

Montreal, Que.

According to information given out at the City Hall, the engineers of Montreal are at work on a report recommending the immediate construction of subways as well as more surface tramway lines. Three subways are in contemplation, one running north and south, another east and west, and a third in the business section. Electric cars will be run in all three tubes, and provision will be made for connection between the tubes and the surface cars.

Through J. D. Lachapelle & Company, Montreal, the Canadian representatives of the C. & C. Electric Mfg. Co., three 75 h.p. complete automatic printing press equipments have been sold to the Star Publishing Company, Montreal, making a total of four equipments of the same size. A complete 400 amperes electric welding equipment with automatic switchboard has recently been sold to the Marine and Fisheries Department, Sorel, P.Q., by the same firm.

Tenders will be called for an electric steel sign for the Imperial Tobacco Company, 900 St. Antoine Street. Cost $8,000.

According to the annual statement of the Montreal Telegraph Company, the property is valued at $2,151,823, this being operated and maintained by the Great North Western Telegraph Company of Canada, its operation and maintenance being also guaranteed by the Western Union Telegraph Company. During the year quarterly dividends amounting to $160,000 have been paid at the rate of 8 per cent.

Contracts have been awarded to McDonald & Willson for the electric light fixtures required for the city hall annex.

The Wheeler Condenser & Engineering Company, of Cateret, N.J., has opened an office at 122 Board of Trade Building, Montreal, under the management of Mr. Jos. McKay, Jr., who has been for several years New York manager of the Wheeler company. The company makes a specialty of surface and jet steam condensers, forced and natural draft water cooling towers, feed water heaters, evaporating apparatus, and special castings for chemical industries.

At a meeting of the Montreal Electrical Society held on January 19, a resolution was passed emphasizing the importance of employing local professional men when expert engineering advice is required for civic purposes. The resolution continued: "We believe that in our city we have the necessary experts and ability to cope with any engineering problem which may present itself, and urge you, as our representatives, to recognize our own citizens in preference to the employment of outsiders." Messrs. P. T. Davies, T. H. Nicholson, and J. Towne were appointed to present the resolution to the Mayor and Controllers. At the same meeting Mr. Bradley T. McCormick, of Forbes and McCormick, Montreal, read a paper on "Induction Motors."

Mr. Tate, chief inspector of the electrical department of the Canadian Fire Underwriters' Association, Montreal, was among the Canadian representatives at the convention of Western Association of Electrical Inspectors, Cincinnati. Mr. Tate is a member of the Theatre & Show Wiring Committee.

A bill promoted by three shareholders of the Merchants' Light, Heat and Power Company has been before the Que-

bec Legislature. The measure asked that the directors should accept any reasonable offer that might be made to them in the interests of the shareholders for the exercise of the powers granted the company; that the company should not amalgamate with any other company having powers partly or wholly similar to those possessed by the company; and that the company should borrow three million dollars on bonds and debentures to be a first privilege on the moveable assets. The company is controlled by the Cedars Rapids Manufacturing & Power Company while the Montreal Light, Heat and Power Company are also largely interested. The legislature declined to alter the charter in the sense asked for by the promoters of the Bill, which was opposed by the directors, as contrary to the interests of the shareholders. Some minor clauses, however, were inserted.

Specifications of the proposed dam on the St. Maurice River, P.Q., have been prepared by the Running Waters Commission. The object is to provide an even flow of water for industrial purposes, and make possible the development of a very large amount of horse power. The dam is to be constructed above La Loutre Rapids, four miles above the mouth of the Wabane River, and will be 1,720 feet long.

Maisonneuve, P.Q.

The shipbuilding plant of Canadian Vickers, Limited, Maisonneuve, P.Q., will be driven by electrical motors, which are being constructed in England by Vickers, Limited. Current at 10,000 volts will be supplied by the Montreal Light, Heat & Power Company, and will be transformed by three large converters to a voltage suitable for the working of the machines and for lighting the plant. An hydraulic accumulator actuated by electrically-driven pumps to give a working pressure of 1,500 lbs. per square inch will also be installed, while in connection with the working of pneumatic tools, there will be two air compressors. A sub-station is now in course of erection.

Newcastle, N.B.

The wireless station of the Universal Radio Syndicate—the owners of the Poulsen system—is nearing completion at Newcastle, N.B. There will be six wooden towers, 300 feet high, and one of steel, 500 feet high, while the number of kilowatts utilized will be 300. The station on the other side is at Bally Union, County Kerry, Ireland. Mr. A. S. Baxendale, the managing director, states that before commencing business a number of experiments will be made in order to test the installation and some appliances which have just been invented.

Nanoose Bay, B.C.

The Giant Powder Company have announced that part of their powder works at Nanoose Bay, Vancouver Island, will be put into operation about the middle of February. The company recently installed a 500 kw. Curtis steam turbo-generator and the plant is motor driven throughout.

New Hazelton, B.C.

The Continental Development Company are installing a hydro-electric generating equipment of 200 h.p. at their Roche de Boule coal claims near New Hazelton, B.C. A motor driven air compressor will be used in conection with the plant, which it is expected will commence operations on March 1.

Niagara Falls, Ont.

Governor Glynn has announced his advocacy of a scheme whereby the present available water on the United States side at Niagara Falls should be taken over by their government and developed according to a general system very similar to that adopted in the province of Ontario. The amount at present available for this purpose is said to be 4,400 c.f.s.

Nickelton, Ont.

It is reported that the Canadian Nickel Corporation are preparing plans to generate their own electric power at this point. It is understood that the reduction works of this company will have an initial capacity of 40,000 tons per month. Nickelton is a recently incorporated town on the Eastern Algoma Railway, which will also be reached by the C. N. R. and C. P. R.

Ottawa, Ont.

The Ottawa Electric Light Company, we believe, are now leading in Canada in the matter of cheap rates for household purposes. Beginning January 1, this rate is 3½c. per 100 sq. ft. plus a meter charge of 2 1-5c. per kw.h. with 10 per cent. discount, the area being computed in the usual way. For commercial premises, hotels, etc., a rate of 5.33c. per kw.h. for the first 30 hours use of installed capacity with 2.22c for all excess and 10 per cent. discount is given. Power rates are in proportion.

Mr. A. M. Beale of the Department of the Interior, Ottawa, has just made an investigation and is now preparing a report on a number of smaller water power sites in western Canada. His investigations were undertaken as the result of numerous applications that had been made to this department during the last few years for the right to develop water power on the smaller streams in connection with small municipal plants, factories, grist mills and even for general farm use. In view of the apparent wide spread interest in the development of smaller water powers for such local purposes and in view of the successful operation of small plants elsewhere it was decided to have Mr. Beale investigate the question fully.

Owen Sound, Ont.

In outlining his policy for the year 1914 the Mayor of Owen Sound expressed the hope that in the near future an improved system of lighting would be installed on the main streets.

Princeton, B.C.

The light and power equipment which is being installed on the outskirts of Princeton, B.C., for the Princeton Coal & Land Company, comprises only the first unit of an isolated plant which will ultimately be erected at this point, the present installation consisting of a 50 kw. Westinghouse generator driven by a Goldie & McCulloch high speed vertical engine. It is intended to utilize light and power in the operation of the company's mines, in addition to supplying the requirements of the town and adjacent district. The entire plant, including the distribution system, is being supplied and installed through Mather, Yuill & Company, consulting engineers, Vancouver, and will be in operation by the middle of February.

Port Stanley, Ont.

The hydro-electric department of Port Stanley shows a net balance of approximately $2,500 for the past year's operation. This does not include depreciation, which at 5 per cent. would amount to about $600, leaving a surplus of approximately $1,900.

Port Arthur, Ont.

During the month of December the combined earnings of the Fort William & Port Arthur Electric Railway Systems amounted to $24,961 of which the Port Arthur end earned $10,868 or about 44 per cent. and the Fort William end $14,092 or about 56 per cent.

Begining January 1, 1914, the Port Arthur rates for domestic and commercial lighting will be as follows:—Domestic—A service charge of 4c. per 100 sq. ft. plus a con-

sumption charge of 2½ per kw.h. with 10 per cent. discount and a minimum charge of 25c. per month. Commercial—6c. per kw.h. for the first 30 hours use of installed capacity and 2½ per kw.h. for all additional consumption with 10 per cent. discount and a minimum charge of 50c. There is no charge for meter rental.

Paris, Ont.

Street lights were used for the first time in Paris, Ont., on January 8. 300 100-watt tungsten units have been installed.

Point Grey, B.C.

Messrs. DuCane, Dutcher & Company, consulting engineers, Vancouver, have prepared a preliminary report for the municipality of Point Grey, relative to the establishment of a municipal power plant and distribution system in that district at a cost of approximately $240,000, this expenditure to be spread over a two-year period. The report favors provision being made for a plant designed to act as a reserve and sub-station for hydro-electric power, and recommends accommodation for a Diesel oil engine and a steam turbine plant with oil fuel boilers, the oil engines to be utilized for lighter loads. The distribution system proposed provides for the erection of pole lines in the outlying parts of the municipality and an underground system in the Shaughnessy Heights district. It is understood that the recommendations of the engineers will be brought up for discussion at an early meeting of the Point Grey council—probably early in February.

Quebec, Que.

A contract has been awarded to the Steel Company of Canada for wire and other equipment in connection with the extension of fire alarm system.

Regina, Sask.

The operating returns of the Regina municipal railway system for the week ending January 3, 1914, are as follows: Revenue, $3,925.80; passengers carried, 92,638; passengers carried including transfers, 103,558. Corresponding figures for week ending January 10 are: Revenue, $3,911.80; passengers carried, 92,383; passengers carried including transfers, 102,576.

The new 1200 motor-converter has arrived and will be installed in the old power house. The present two, 400 kw. steam engine generator units will be maintained in future as a reserve. Satisfactory progress is being made on the new power plant near Lake Waseana where all power will eventually be generated, the old power house being used as a substation.

Rockwood, Man.

Permission has been given by the Rockwood council to the Winnipeg city light and power department to carry on a light and power business in the municipality of Rockwood. This municipality is already served by the Winnipeg Electric Railway Company.

Saskatoon, Sask.

A contract for the electrical work in connection with the government elevator has been let to a United States firm. There is considerable feeling among the local contractors as a result.

The municipal railway system of Saskatoon will use colored lights to indicate the route of the different cars.

St. Thomas, Ont.

The domestic lighting rate in St. Thomas beginning January 1, 1914, is 4c. per 100 sq. ft. plus a meter charge of 2½c. per kw.h. less 20 per cent. discount and a minimum monthly charge of 25c. The other rates are as follows. Commercial lighting—6c. per kw.h. for the first 3 hours' use of installed capacity and 2½c. per kw.h. for all additional consumption with 20 per cent. discount and a minimum charge of 50c. Power—A service charge of $1.00 per h.p. per month with a consumption charge of 2.5c., 1.7c., 0.2c. with 10 per cent. discount. Street lighting—$9 per 50 watt lamp, $10 per 75 watt lamp and $55 per arc per annum.

The operations of the municipal street railway system in St. Thomas, Ont., showed an approximate increase for the past year of $5,000 over the previous year.

Sydney, N.S.

It is reported that the Broughton Coal & Iron Company are considering the installation of an electric power plant, the power to be used in connection with the mining operations of the company.

The gross revenue of the Cape Breton Electric Company for the year 1913 was $374,883, an increase of $25,000 over the previous year. The net increase was $13,000.

Sherbrooke, Que.

The annual statement of the electric light and gas department for the city of Sherbrooke shows a balance on hand of over $15,000. This is after allowing liberally for maintenance and depreciation.

St. Marys, Ont.

The St. Marys, Kirkton & Exeter Telephone Company installed 62 telephones during 1913, making a total of 660 phones in service to date.

Strathroy, Ont.

A by-law will be submitted during February on the question of obtaining power from the Hydro-electric Power Commission of Ontario.

Spanish River, Ont.

The International Nickel Company are reported to be preparing plans for a new hydro-electric plant on the Spanish River which will double their present power and smelting capacity.

Stratford, Ont.

Considerable extensions to the electric lighting system will be made in the near future.

The electric department has shown a considerable surplus, in the neighborhood of $10,000 for the year 1913.

The electric business of Mr. Heideman has been purchased by Mr. E. Etherington, recently in the employ of the Stratford Mill Building Company, Mr. Etherington will carry a complete and modern stock of electrical fixtures and will also execute contracts for all kinds of electric wiring.

St. Catharines, Ont.

The Niagara, St. Catharines & Toronto Railway Company have purchased six interurban cars from the Preston Car & Coach Company. The body of these cars will be 56 ft., steel underframing, steam coach type of hood, and full empire interior finish. Three of the cars will be equipped with combination baggage and smoker. In the other three the baggage compartment will be eliminated. They will be equipped with multiple unit control for train operation, the intention being to operate the main line cars in trains of one or more units, according to the traffic. The equipment also includes Taylor trucks, electric markers, electric classification lamps, air sanders, etc. Weight of car completed will be about 65,000 lbs. and each will seat about 66 passengers.

The N. S. & T. Ry. Co. will install during the early summer a rotary converter set at Niagara-on-the-Lake consist

ing of a 750 kw. Westinghouse unit, 375 volts on the a.c. side and 600 volts on the d.c. side. Power will be supplied by a 13,000 volt line which parallels the company's track from St. Catharines to Niagara-on-the-Lake where reducing transformers are installed. Power is supplied, of course, from the Toronto & Niagara Power Company's line. The building and machinery at this point will cost in the neighborhood of $25,000.

The company are also installing a new converter station at St. Catharines to be equipped with two C. G. E. 500 kw. converters and the necessary appliances. This station when completed will cost about $35,000.

St. John, N.B.

A conference was recently held between representatives of the St. John Street Railway Company and the municipal council at which terms were agreed upon for the extension of the railway line early in the summer from the present terminus through East St. John to Little River. This will open up a considerable residential section. It is said that the owners of new factories at Coldbrook, and others, have approached the railway company urging that the line be further extended to Coldbrook.

The Maritime Electric Company have been awarded a contract for the installation of the electrical equipment in the I. C. R. station at Moncton.

The Knox Electric Company have just completed the electric installation in a number of houses for the Fenton Land and Building Company.

The Stores Department of the St. John Railway Company will in future be known under the name of the Eastern Electric Company.

Mr. W. H. Dykeman has opened an electric store on Princess street, St. John.

The electrical contractors are endeavoring to form an association at St. John, N.B.

Toronto, Ont.

The Automatic Electric Cook Company suffered by fire to the extent of $20,000.

The management of the Grand Trunk Railway System will install a system of telephones in their Toronto terminals. It is understood that some 150 telephones will be required connecting Little York, Don, Mimico, Parkdale, Davenport and New Toronto.

R. C. Harris, Commissioner of Works, has been asked to report on a civic car line at the Beach to connect with Gerrard and Danforth; on the Lansdowne Avenue extension and on a belt line in Ward 7.

Two new double truck cars were recently placed on the lines of the Toronto Suburban Railway Company.

The Board of Control has decided to install an electric inspector for the city as required by the hydro-electric act passed some time ago by the Ontario legislature.

Truro, N.S.

Beginning January 1 the Chambers Electric Light & Power Company's contract with the town, for lighting the streets, expired. In future the streets will be lighted by the town plant and the Chambers Company will confine their attentions to the household and commercial supply.

The matter of rates to be charged by the Chambers Electric Light & Power Company in Truro recently came before the Public Utilities Commission of Nova Scotia. The rates decided upon were as follows:—15c. per kw.h. for the first 15 kw.h. use in any month; 12c. per kw.h. from 15 to 50 kw.h. each month; 9c. from 50 to 150 kw.h. each month; 8c. for all in excess of 150 kw.h. each month. All motors and heating appliances with a capacity not exceeding 1 kw.h. pay for current at the lighting rate as outlined above.

Power and heating rates for greater consumption were placed as follows:—12c. for the first 50 kw.h. per month; 9c. from 50 to 100; 8c. from 100 to 200; 7½c. from 200 to 500, and 7c. for all over 500.

Terrabonne, Que.

The plant of the Terrabonne Light, Heat & Power Company suffered by fire to the extent of $4,000.

Vernon, B.C.

A report of the electric light department of Vernon for the year 1913 shows the total number of kw.h. generated as 511,986 comparing with 335,646 in 1912. The maximum demand was 420, as compared with 266. After deducting expenses, 5 per cent. depreciation and interest on debentures, there is a net profit of $1,393.

Vancouver, B.C.

The Hinton Electric Company, Limited, have gone into voluntary liquidation.

Windsor, Ont.

It is expected that the new hydro line will be ready to deliver power in this city by April 1.

Winnipeg, Man.

The earnings of the Winnipeg Electric Railway Company on their city system for the past year were $2,584,597, an increase of $269,604 over 1912.

A contract has been awarded to the Canadian Motor Company for a 3½ ton Detroit electric truck for use by the electrical department of the municipality of Winnipeg.

A contract has been awarded to the Star Electric Company for 30 fire alarm boxes.

Tenders have been called for the placing of the tower footings on the new line to be built by the city of Winnipeg between the city and the generating plant at Point du Bois.

The financial statement of the Manitoba government telephones for the year ending November 30, 1913, shows a net surplus of $30,264. It is understood, however, that allowance has not been made for either depreciation or sinking fund for the retiring of the debentures as they come due. The amount mentioned as reasonable for the depreciation is $26,690 which leaves $3,574 to be set aside toward the sinking fund. As the total investment of the province in the telephone system is now over $10,000,000, neither the depreciation nor the much smaller amount for the sinking fund would appear to be at all adequate. It will be remembered that the telephone rates were recently increased, but even this does not appear to have been sufficient to provide for operating and other legitimate expenses.

Weston, Ont.

The electric light and water-works commission have decided to repair the old steam electric plant on Little avenue and maintain it as an auxiliary in case of a break-down in the hydro supply.

Walkerville, Ont.

Sub-contracts have been awarded for the construction of the Walkerville distribution station to the H. G. Christman Company, Hamilton; The Canadian Bridge Company, Walkerville, and R. Paddon & Company, plumbers, Windsor.

Yorkton, Sask.

A contract has been awarded to the Boving Company of Canada, Limited, for the supply of one 500 B.h.p. Diesel oil electric generator unit. Mr. M. M. Inglis is electrical engineer for the town.

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Provincial Inspection Work Being Rapidly Taken Up

Municipal electrical inspection under the supervision of the Hydro-electric Power Commission is now making decided progress, and the electrical fraternity at large is beginning to realize that this work is being taken up in real earnest. Before the end of the year 1914 there will be a great many inspection departments throughout the Province. To date, the following municipalities have appointed electrical inspectors and are more or less organized for work, and in some cases have already put the Rules and Regulations strictly in force.

The first city to take the matter up was Ottawa, the work there being placed under the chief inspectorship of Mr. Norman E. Bell, late inspector of the Fire Underwriters in that city. He is assisted by Mr. Croydon and good work is being done. The other municipalities and their inspectors follow:—Port Arthur, Stirling Jaffray; Fort William, A. D. Smith; Stratford, Geo. E. Heideman; Berlin, H. C. Fischer; Goderich, W. H. Bullard; Clinton, H. B. Chant; London, W. B. Legate; Tillsonburg, John E. Teckoe; Woodstock, H. Webster; Petrolia, W. H. Somers; Parry Sound, G. Groves; Barrie, W. Macdonell; Brockville, E. J. Philip; Kingston, Thos. A. Hanley.

In addition to the foregoing the city of Hamilton have also appointed a chief electrical inspector. Up to the time of writing the appointment has not yet been ratified, as it has been made subject to the approval of the Hydro Power Commission. The town of Welland also appointed an inspector which has not yet been ratified by the Commission, and there are some 20 or 30 other municipalities, including Toronto, now negotiating with the Commission, who will likely make appointments in the near future.

The appointment of electrical inspectors in the municipalities is subject at all times to the approval of the Hydro-electric Power Commission of Ontario, a requirement which has a tendency to eliminate the appointment of political favorites and incompetents. The appointment of municipal electrical inspectors has always been looked upon by the electrical trades as problematical, owing to the element of incompetency which has been so prevalent in the selection of men to fill the position.

The Hydro Power Commission have a department of rules and regulations under the management of an electrical inspector well known to the electrical fraternity at large, and the supervision of the various inspectors and their work will be at all times subject to the Commission, and so long as good men are selected and the Commission hold inspectors to a strict accounting of their work, the electrical contracting and engineering fraternity will have every cause to rejoice in the enforcement of the regulations.

We learn from the manufacturers and dealers in supplies that already old code wire is going begging, and in some localities cannot be disposed of for love or money.

The Influence of Fares on the Riding Habit

At the mid-year meeting of the American Electric Railway Association, Mr. F. W. Hild, general manager of the Portland Railway, Light & Power Company, discussed at length the effect, on gross earnings, of rates of fare charged on electric railways, taking the ground, which he backs by actual figures, that the fare charged is one of the least important factors regulating the extent to which street cars are patronized.

The statement will probably be received with some surprise by the average patron of street cars, but is nevertheless correct, that a comparatively small percentage of Canadian electric railways are proving profitable for the investors; possibly not more than 20 to 25 per cent. And yet street railway managements are continually confronted with requests for lower fares backed by the theoretical argument that the increased traffic would much more than offset the reduction. Actual figures, however, do not appear to bear out this theory. As Mr. Hild points out, the greatest incentive to an increased use of street cars is an improved and more frequent service. The increases must necessarily come, for the most part, in short rides, and unless the service is such that the patron can save time he generally prefers to walk. The whole question therefore appears to resolve itself into paying for what we get—good service, high rate—poor service, low rate. It is well to bear in mind also that street railway fares and the cost of electric service generally are almost the only items in our daily expense account that have not increased materially in the past few years. With increased cost of operation, higher cost of material and the demand for better service, the outlook of the future is not encouraging for cheaper transportation. Extracts from Mr. Hild's paper are printed elsewhere in this issue.

The Nitrogen Lamp

The half watt nitrogen filled lamp which has previously been described in the Electrical News has reached Canada at last, and it is probable that installations of street lighting using this equipment will be made during the next few weeks. Already in the United States there are at least two cities using the nitrogen filled lamp, which are said to give very excellent satisfaction with low maintenance charges.

One manufacturing company has brought into Canada about half a dozen 1,000 to 2,000 candle power lamps, one of which is at present on exhibit in Belleville, one in Toronto and one in Hamilton. In Toronto a 2,000 candle power unit is being tried out at the intersection of King and Yonge streets, the busiest corner in the city, and the illuminati

effect is certainly very satisfactory. In sizes down to 750 watts this lamp shows an efficiency of ½ watt per candle-power, or better, though below this point the efficiency is somewhat less, gradually decreasing with the smaller sizes of lamp.

Government Reserves Water-Power Sites

Consistent with the policy of the Dominion Government to preserve the water powers for the people, the Department of the Interior is placing under reservation all vacant Dominion land that the Superintendent of Water Powers may recommend to be valuable for the development of water power.

Six whole sections of land, in township 108, range 6, west of the 5th meridian, have recently been reserved from disposition of any kind until the engineers of the Water Power Branch have had an opportunity to make a complete survey of the famous power site at Vermilion falls, on the Peace river in northern Alberta.

Similar reservations have been made on the various rivers in the provinces of Manitoba, Saskatchewan, Alberta, and in the Railway Belt of British Columbia. Particular mention might be made of reservations covering land contiguous to Grand Rapids on the Athabaska river, the various power sites on the Elbow and the Bow rivers, in the province of Alberta; for land required for the development of power at Grand rapids on the Saskatchewan river, and all unoccupied land along the Winnipeg river, in the province of Manitoba.

Other reservations will be made from time to time upon the receipt of sufficient information to enable the Superintendent of Water Powers to make a definite recommendation covering a description of the land that might be required for power purposes.

Government Estimates for 1914

The estimates of expenditure for the fiscal year ending March 31, 1915, have just been published in bound form by the Dominion government. The grand total amounts to $190,735,176, of which the two largest items are for railways and canals, chargeable to capital account, $29,983,050, and public works, chargeable to income, $28,330,048. For public works, chargeable to capital account, the estimated expenditure is $11,690,500.

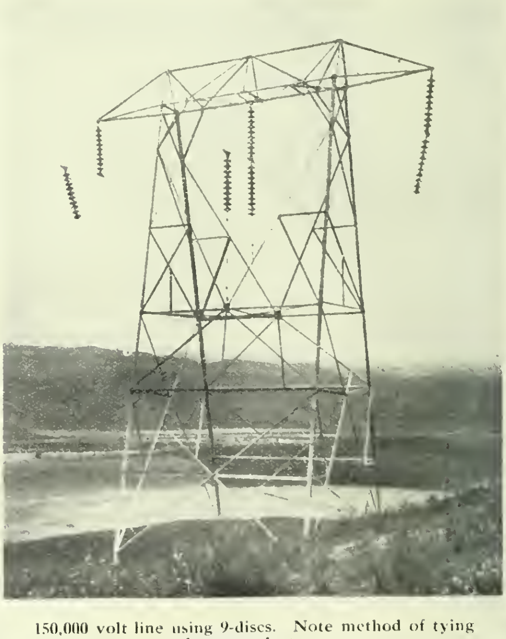
A number of items are of particular interest to electrical men in addition to the public works which consist chiefly in the construction of public buildings, in connection with all of which there will be work for electrical contractors. Of the larger items may be mentioned the installation of telephone systems in connection with the operation of the Intercolonial to cost $64,000; power plants in connection with the same road $20,000, and electrical equipment for charging the batteries on electrically lighted cars, $1,000. The re-wiring of the Ottawa legislative buildings will cost $60,000. Telegraph lines to the value of $622,000 will be constructed at different points in Canada. Another item of importance is an estimate of $370,000 to provide for the building and maintenance of wireless stations in connection with the department of naval service.

Toronto Section A. I. E. E.

Mr. N. W. Storer, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., recently addressed the Toronto section of the A. I. E. E. in the Engineers Club on the "Electrification of Steam Railways." Mr. Storer dealt particularly with high voltage single-phase electrification, but expressed the opinion that neither this system nor the high voltage direct current system have yet reached the limit of their development possibilities and that in the mean time it is not possible to say that any one system is the best. The latest development in high voltage a.c. trunk line work consists in the use of three-phase motors off a single-phase transmission line through phase converters. In this equipment the regenerative possibilities of the three-phase motor are utilized to the fullest extent along with its other advantages. Mr. Storer's remark that the aim of the manufacturer and operator alike should be towards the development of the best system, whether a.c. or d.c., rather than of any particular system at the expense of another, met with general approval. It must not be lost sight of, however, that the keen competition of the past among the larger manufacturers in their advocacy of their own special equipment has played a large part in the present state of high development of all the systems.

Operates 150,000 Volts

A detailed description of the 240-mile transmission line of the Pacific Light & Power Corporation, which operates at 150,000 volts is given in a recent issue of the Electrical World. Power is generated at 6,600 volts by generators of 17,500 kv.a. rating, 50-cycles, 375 r.p.m. and stepped up through 6,000 kv.a. single-phase transformers. There are two steel tower lines each carrying a three-phase circuit with the conductors in a horizontal plane. The towers are spaced on the average 660



150,000 volt line using 9-discs. Note method of tying down conductors.

ft. apart. Conductors are placed with a minimum clearance of 25 ft. The double tower lines are 80 ft. apart on centres.

The high voltage conductor is of aluminium with steel core, the outside diameter being .95 inches and the weight 4,058 lbs. per mile. The core is composed of seven strands of double galvanized plow-steel, .105 in. in diameter per strand, and the maximum stress figured for the conductor is 7,500 lbs. The conductors are spaced 17.5 ft. apart horizontally. The General Electric and the Westinghouse Companies supplied

the equipment. The insulators, of course, are of the suspension type, one unit consisting of nine discs. On anchor towers two sets of 11 discs are coupled in multiple.

New Power House for Swift Current

A new power house is at present being built for Swift Current, located adjacent to the Canadian Pacific Railway. The building is of brick and concrete foundations, with steel columns and roof trusses, and is divided by a center wall in to an engine room forty feet in width and a boiler room 56 feet wide, the length of the building being 61 feet. A concrete tunnel 62 feet long connects the cooling pond, which is 48 feet by 36 feet, and 6 feet deep, with the main building.

The engine or generator room is 27 feet high between the floor and the roof trusses, there being a 10-foot monitor running the length of the roof, and the walls are faced with pressed brick 8 feet from the floor. There is to be a 10-feet deep concrete basement in which the condensing apparatus will be installed. Ample light and ventilation is provided by five large steel framed windows with horizontal swing casement and monitor ventilators.

Two 2,300 volt alternating current electric generators direct-connected to two high speed vertical steam engines—capable of generating 200 and 400 kilowatts respectively—will be installed, while a third large unit can be installed without extending the building. One steam engine driven and one motor driven exciter, each capable of exciting the two alternators, and a black marble switchboard on which will be mounted the high tension switches and controlling gear, are also installed in the generator room, which will be provided with one 10-ton travelling crane to facilitate the erection and repair work on the various machines.

The boiler room is to be 30 feet high from the floor to the steel roof trusses, which also carry a large monitor with ventilating casements. There will be four large steel frame windows in the west wall beneath which schutes will be provided through which coal can be unloaded from the cars on the spur track immediately outside the building direct on to the firing floor.

The foundations for two batteries of boilers, with two boilers in a battery, are being built in the boiler room, and on these three boilers, each of 300 horse power capacity, are being installed. These boilers are of the Babcock and Wilcox safety water tube type, and are equipped with superheaters which will deliver steam at 150 pounds pressure, superheated 100 degrees Fahrenheit, to the engines. These boilers will be hand fired at present, though the foundations have been made suitable for mechanical stokers, and heavy enough to carry overhead coal bunkers of 300 tons capacity to each battery.

The exhaust steam from the engines will pass into surface condensers, circulating water for which is provided in the cooling pond already mentioned, and the condensate will be pumped into an open heater located in the engine room to which the raw make-up water will be added and treated so as to provide perfectly pure soft water for feeding the boilers.

The exhaust steam from the two boiler feed pumps and the condenser pumps will be used to heat the boiler feed water, so that it will enter the boilers at from 190 to 200 degrees Fah., thus saving a considerable percentage of fuel.

The 200 kw. generator and two boilers, the feed water heater and pumps will be installed and completed this season and a temporary wooden building is being placed over them. The centre and north walls of the permanent building are being built to a height to allow of the completion of the building next spring in such a way that the plant can be kept in continuous operation during its completion.

The cooling pond will be completed this year, and will provide an auxiliary water supply during the winter, and will be ready for the condensers when they are installed next spring.

A New Principle in Transmission

By Mr. H. B. Dwight

The 240-mile transmission line of the Pacific Light and Power Corporation, between Big Creek and Los Angeles, which has recently been put in operation, is a record-breaking one in several respects. It is the longest unbroken transmission line; it uses probably a larger size of cable, and at wider spacing, than any other long distance line; and it employs a higher voltage than has previously been commercially used. Possibly more important still, although comparatively little attention has been called to it, is the fact that this difficult transmission project could probably not have been carried out as a commercial success without the employment of a new principle—that of doubling the power rating of the line by using synchronous motors to give power-factor control of the voltage. In other words, only a "constant-voltage" line is economical at the higher frequencies for distances as great as 240 miles.

This large transmission project should be of interest to all electrical men, whether they are interested in transmission lines or not, because the lesson it points regarding the actual money value of power-factor control is applicable, in a lesser degree, to a great many cases of 2200 volt work as well as other voltages up to the highest in use. It applies to many cases of city distribution as well as to transmission lines. The best methods of operating synchronous motors, and of estimating the benefits from power-factor control, are worth considerable study.

The builders of this line have published little regarding the purpose of the various features. However, more or less complete data is available, from which some conclusions regarding power transmission in general may be drawn.

The normal voltage of this 240-mile line is 150,000 volts, and the frequency is 50 cycles. The cables are of aluminum, of slightly more than 15-16 inch diameter, and with a 5-16 inch core composed of 7 steel wires. The cables are spaced 17½ feet apart in a horizontal plane. The large cable size and wide spacing allow the use of very high voltage without danger of corona loss. Two complete transmission lines have been built, each consisting of one three-phase circuit on a separate line of towers.

There are two water power plants at Big Creek. Each contains two 17,500 kva., 80 per cent. p.f. generators, and has an ultimate capacity for six generators. The total amount of power planned to be developed in these stations is thus 168,000 kw., and there is water power for even further development.

At Los Angeles the voltage is stepped down for supplying a load composed partly of induction motors for irrigation pumps and motor-generator sets for railway work. A very important feature of the receiving station consists of two 15,000 kv.a., 375 r.p.m. synchronous motors, or synchronous phase modifiers. These are being run at present without any mechanical load, for the sake of their effect on the transmission line voltage. They are adjusted automatically by Tirrill regulators to give sufficient leading or lagging current to hold the voltage constant when the load varies.

The importance of the synchronous phase modifiers is evident from a consideration of the amount of power which can be transmitted, and of the relative cost of different parts of the system. First, without any power-factor control, the maximum 85 per cent. p.f. load which one line can supply is determined as usual by the voltage variation and is 22,000

kw. This load gives 15 per cent. voltage variation from no load to full load, due to line drop, or about 22 per cent. total variation including the drop in the transformers, assuming a maximum working voltage of 150,000 volts. This is evidently maximum allowable variation.

Allowing the same voltage variation and the same maximum working voltage, a load of 15,000 kw. at 85 per cent. p.f. can be supplied by one line when one 15,000 kv.a. synchronous phase modifier is used. Thus the synchronous machine doubles the power rating of the line. It may be mentioned that the capacity of one line has been announced to be 60,000 kv.a.

A rough estimate of first costs based on the above data gives about $1,000,000 as the cost of the material in one transmission line, while the cost of one synchronous machine, with transformers and other appurtenances, is about $120,000, at current prices. Extra power plant development must be made to supply the extra losses in the line and in the synchronous machinery when power-factor control is used, and this will cost about as much as the synchronous phase modifying machinery. While it might be out of the question to build enough of these million-dollar lines to transmit the entire power of the generating stations in the usual way without any power-factor control, the transmission may be effected commercially by building few lines and using synchronous phase modifiers.

It may be noted that if two 15,000 kv.a. synchronous phase modifiers are used, the line becomes a constant-voltage line with no variation at any point for all loads up to 42,000 kw.

In conclusion, it may be said that wherever there is a limitation to the voltage, whether due to previous construction, to the necessities of city conditions, or to corona loss, then voltage variation and the cost of lines will be predominant. In such cases, synchronous motors produce striking economies in line costs, but they must be continually adjusted with the aim of holding the voltage constant, and for this they must operate, at certain times, with a lagging power factor. At times of heavy load they have the usual beneficial effect on the generator power-factor. Thus the common rule that synchronous motors should be adjusted so as to show 100 per cent. p.f. at all times on a power-factor meter connected to some part of the load should in many cases be changed in favor of the rule of adjusting for constant voltage.

Car of the Future—The Electric

By Dr. Chas. P. Steinmetz

The future of automobiling belongs to the electric, and for the following reason: to-day automobiling is still essentially a sport and for this purpose to most people the gasoline car appears to have the advantage of being capable of higher power of motor, therefore higher speeds and to go longer distances across the country without requiring charging stations, since gasoline can be bought now almost everywhere.

You have heard from Col. Bailey's talk that the electric automobile is equally capable of long distance touring and that even to-day you can make shift by getting charges, and it is only a question of organizing a system of charging stations all over the country to make the electric touring car equally capable of going over long distances and therefore more suitable for this purpose.

However, it is not this in which I believe the main use of the automobile lies, because as I said before, it is still essentially a sporting proposition. Eighteen years ago we all thought the bicycle had come to stay as an every day utility, as a business conveyance, still it is banished for this purpose. We don't go to work on the bicycle any more, but use other conveyance. But, nevertheless, the bicycle is to-day used just as much as it ever was used, only now it has become a business conveyance. You use it where you want to cover some distance most conveniently. Now, it is my opinion that very much of the present use of the automobile by the lawyer to go to his office, or by the engineer to go to the factory and back, is of the same class as the use of the bicycle 18 years ago—it is the thing to do—everybody who can afford it gets an automobile and runs an automobile.

Driving an engine through the streets of the city is all right for sport, but it is not feasible when the sporting idea is mixed with every-day occupation, any more than you drive your own horse except for sport; though to-day when you attend any meeting of people that own automobiles and begin to speak about automobile matters, they all can intelligently discuss them and they get very much interested talking about carburetors and spark plugs and ignition devices and so on, just as 18 years ago the same class of people were capable and interested and could as intelligently, when you mentioned the subject, talk of chain-drive and gear and bicycle tires, single tires and double tires but that is really outside of the natural inclination—is a temporary condition of sport.

Now we see already to-day the automobile beginning to recede from the sporting attitude. We see already many people that can afford it not taking pleasure in driving their own car but having a chauffeur drive it. But the majority of people cannot afford a chauffeur and they must either abandon the use of the automobile altogether or drive their own car.

Now I believe that the gasoline engine, while it is very simple and very well developed and will still be made more simple in the future, I say that it is an engine which is not much that the average business man or lawyer, or professional man who is not an engineer can handle, can take care of and take pleasure in taking care of, where they are not, as a sporting matter, interested in it. Naturally, when one is interested in an automobile as a means of diversion and sport one can do anything, but the human race as a whole does not keep up such an interest for a long time.

Now what I want to draw your attention to is—the beginning of this change of the automobile from a sporting proposition to a business proposition, from a sporting-pleasure vehicle to a business vehicle, not the pleasure of going itself, but going for business, going to some place with a definite object—that has already come.

The only car which will remain in general use is the car which everybody can take care of because it does not require any care; that means "electric" and the future of the automobile as a business vehicle, as a carriage, is the "electric" because it does not require any special knowledge, any care—anybody, any lady, can run it. The electric automobile may be, and is, capable of doing all that the gasoline car can do, but, ladies and gentlemen, I believe that, just as eighteen years ago we have seen, on a pleasant Sunday or holiday, thousands and thousands of bicycles going all over the country, from New York and Boston to Albany touring—all have vanished, likewise we will see automobiles very largely vanish from touring. The automobile is all very well, but when you wish to go for hundreds of miles the Pullman car is really more comfortable.

Now it is all right when you want to enjoy nature. People will always go out across the country on bicycles, in automobiles, on motor cycles, in horse carriages and so on, but they form a very small minority. The long distance touring car is a temporary advantage, but in the final development when the automobile has come to be an every-day affair, a business proposition and not a sporting idea, that will be a matter of secondary importance.

That means with the automobile vehicle or automobile

Paper presented before the Electric Vehicle Association.

carriage development, an electric carriage for every-day use. It means we do not need mileage of 100 miles or so. The every-day use of the average man going around town to business or elsewhere is from 10 to 20 miles a day, and a radius of 10 to 20, or possibly 30 miles will cover any business proposition—probably 95 per cent. or more. You see what that means—you can get a very small light battery, a light carriage.

Now, there are many expensive gasoline cars used to-day and will be, but still with the majority the simple carriage is what is needed. True, we have the horse and buggy, but the average man cannot afford a horse and buggy because it requires care and attention to keep a horse and you cannot keep it in a city without great expense. But the average man can afford an electric carriage, because it requires no attention and there is the main future for the electric carriage—it makes the owner independent of trolley cars, independent of railroad cars and allows him to go anywhere and everywhere: and that will be, in my opinion, the main feature of the automobile in the future when the condition has become stationary, when the first enthusiasm for automobiling as the greatest of all sports will have somewhat dwindled away. It will not mean a reduction of their use, but rather, an increase. If you look into it, probably you will find that more bicycles are used to-day than there ever have been but they are not conspicuous because not any more used for sport, except occasionally.

Now, when you consider, if we had an electric carriage in every-day use it would be quite feasible to arrange for charging it at a moderate monthly cost, say $10, or $5 a month. The illuminating company or the local company in a city or country town anywhere takes care of the electric car. You run it there in the evening and in the morning you go there and take it out, it having been charged during the night. A light charge is ample for all the use you will have for it during the day.

Indeed, you may, in many cases, go further. You may arrange that a nominal additional charge be made by the illuminating company and they send the automobile to your house and leave it in front of your door and in the evening when you arrive home the illuminating company send for it. Now, it doesn't cost much extra; you can get a messenger say for 20 cents a trip, and it probably even with this would cost less than $10 a month because it isn't used every day, so it isn't probable it would cost that; it is such a small charge it is not of moment. "Oh," you might say, " what if somebody wants to use a car very much more, you would need more mileage." Well, you could have an additional charge from some other contractor, whereby you get a boost charge in your carriage from any illuminating company in the country by showing his card. It would not be difficult if both sides the electric automobile industry and the electric operating company co-operate, have an interchange of courtesies by an annual payment or monthly payment of a certain amount, whereby the automobile is entitled to be charged everywhere and anywhere—merely run it into any illuminating company's garage, show your card, get a boost and go away again. Now, that would make it the simplest thing in the world. It would make it the ideal carriage which anybody, any lady can have, because there is no trouble connected with it, anybody can run it, any lady or child—you just telephone to the illuminating company's garage and have somebody bring it to you and when you are through with it you have somebody take it back and you have your monthly rental and that is all there is to it.

At a recent meeting of the town council a resolution was passed favoring the holding of a joint conference at Listowel to discuss the possibilities of securing Niagara Falls power and light throughout this district.

Calgary's 12,000 Volt Distribution

The drawings herewith are descriptive of the 12,000 volt distribution net work of the city of Calgary, Alberta. The city buys power from the Calgary Power Company who have a water power plant on the Bow River about 60 miles up stream in the mountains. This company delivers its power over two 55,000 volt transmission lines to the terminal station in the south-east part of the city. At this point the voltage is reduced to 12,000.

The city also owns a reserve steam plant located at Victoria Park which has a capacity of about 11,000 kw., which is generated at a voltage of 2,300. The voltage is stepped up to 12,000 by means of a 3-phase, 3000 kv.a. transformer and 3 single-phase, 1000 kv.a. transformers located in a switch house about 100 feet distant from the power house. The 12,000 volt buses of the Calgary terminal station and the Victoria Park switch house are tied in together as shown in Fig. 1.

There are 4 main sub-stations and two out-door transforming stations.

No. 1 sub-station, located on 9th Avenue and 7th Street West, is fed underground by two 12,000 volt, 3 conductor No.

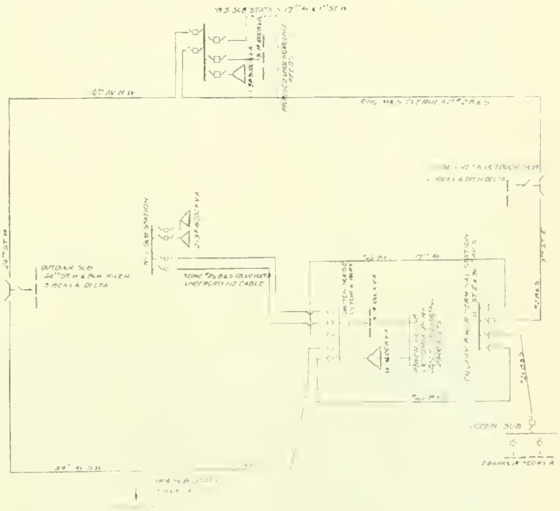


Fig. 1. General plan of Calgary's distribution system.

00 B & S. paper insulated, lead covered cables which are routed in different duct lines to prevent trouble on one being transmitted to the other. This station is shown in the central portion of Fig. 1 where it is seen that there are two 3 phase, 3,000 kv.a. transformers installed which reduce the voltage to 2300.

Sub-station No. 2 is located at Ogden and supplies light and power to that suburb and to the C. P. R. shops; also direct current to the street railway. This sub-station is supplied at present by an overhead 12,000 volt feeder from the 12,000 bus to the Calgary Power Company's terminal station. Ultimately there will be two 12,000 volt feeders to this sub-station. In this sub-station there are two banks of three 500 kv.a. single-phase transformers.

No. 3 and No. 4 sub-stations and the two out door transforming stations are fed from a 12,000 volt ring transmission line which surrounds a portion of the city approximately 4 miles long and 3 miles wide. The ring line is sectionalized at each sub-station so that any section of the ring can be cut out

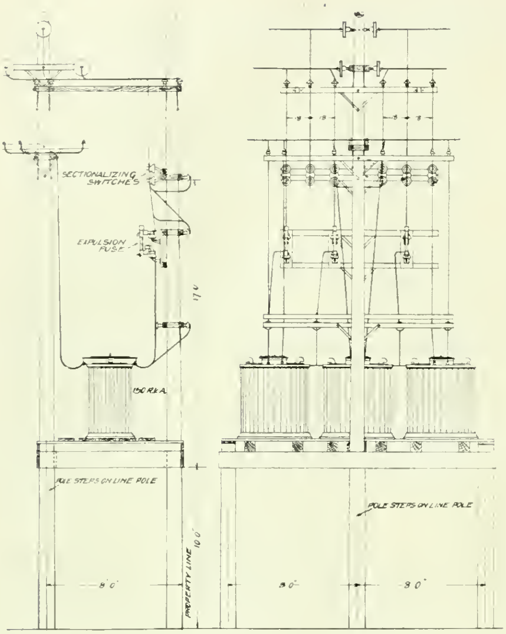


Fig. 2.—Typical outdoor transformer station.

for repairs without interrupting the service. No. 3 sub-station contains one 3-phase, 3,000 kv.a. transformer and three single-phase, 1,000 kv.a. transformers. No. 4 contains three 100 kv.a. single-phase transformers.

The two out-door sub-stations consist simply of a bank of transformers supported on a platform bolted to the line poles. On these poles are also mounted sectionalizing switches for the ring main and some expulsion type fuses for the protection of the transformers. Fig. 2 is a diagram of one of the out-door stations used at the present time. Fig. 3 shows a section through No. 1 sub-station.

In Fig. 1 will be noted a dotted line leading to sub-station No. 3 which represents the location of the proposed underground feeders to that sub-station.

The total business for the year 1913 of the electric light

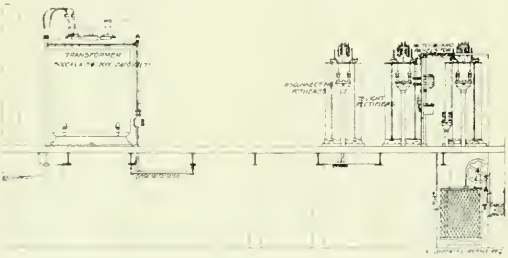


Fig. 3.—Section of No. 1 sub-station.

department in Calgary was approximately $696,000 with a surplus of approximately $70,000. This is the best year the plant has ever had both in respect to gross and net revenue. The city provides out of this gross revenue (together with all overhead operating expenses) for interest at 5 per cent., sinking fund at 2 per cent. on 30-year debentures, depreciation on the gross capitalization at 5 per cent. and a special meter fund of $1.20 per year per meter for repairs and renewals, which is equivalent to additional depreciation.

The superintendent of the electric light department of the city of Calgary is Mr. R. A. Brown under whose management this very efficient and economical system of distribution has been worked out. In this connection too it might be mentioned that the illumination of the city of Calgary is among the brightest on the continent, this city being one of the first to adopt the new magnetic arc. Much credit for the excellence of the work of this department must also be given commissioner A. G. Graves, the appreciation of whose work by the citizens was recently indicated by his re-election for another term.

Electricity in the Lumber Mill

Showing How the Advantages of Electric Drive are Being Proven in the West

The advantages of electrical drive in lumber mills have of late been recognized by modern millmen, this drive having been adopted in nearly all of the lumber mills erected during the last few years. Experience shows that it possesses the advantages of efficiency and economy and practically eliminates line shafting and belting, thus reducing the upkeep expenses to a minimum. The important features in connection with electric drive are the ability to locate the machinery where most convenient to avoid rehandling the lumber, and to operate any group of machinery or any individual machine at any time.

That isolated electrical power plants in connection with lumber mills, where fuel is available at practically no expense, has proven a commercial success, is an undisputed fact. A suggestion a few years ago that met with a good deal of incredulity was that in the near future the central station would be supplying power to operate lumber mills. This phase of the question has received an increasing amount of attention, however, and judging from the number of mills already receiving power from central stations, it is fair to assume that, where an uninterrupted service is available it possesses many advantages worth investigating by millmen.

The accompanying description of a modern electrically-driven saw and planing mill erected by E. H. Heaps & Company, Limited, at Ruskin, B.C., tends to substantiate the statement that the central station has entered the field and is apparently meeting with success. The plant and town site, occupying an area of 152 acres, enjoys an extremely favorable location, having frontage on the Fraser River and being bounded on the east by the Stave River which affords absolutely ideal facilities for holding logs. The plant commenced cutting early in 1913, running in the main side only. When completed it will have a daily cutting capacity (10 hours) of approximately 250,000 feet of lumber, 500,000 shingles and 50,000 lath. The sawmill is housed in a three-storey building, which is 402 feet long and has a width of 110 feet in one part and in its narrow portion is 64 feet wide. One side was operated for several months last season, and the second side will be fitted up in the near future as a short log mill, the machinery for which is now on order. The sawing machinery at present installed consists of a 10-ft. Allis single cut band, an 84 x 12 heavy Allis Pacific Coast edger, 7-foot Mershon band re-sawing machine, automatic air trimmers, slab slashers, etc., and a Stetson Ross automatic sizing machine. The mill is also equipped with the latest Simonson log turners, kickers, automatic transfers, etc. The planing mill occupies a building measuring 121 x 134 feet. Arrangements have been completed for the construction of the shingle mill, 35 x 120 feet, and lath mill, in time to cope with the early summer trade. The erection of

the shipping shed 70 x 120 and a large drystock shed, will also be proceeded with during the early spring. Six dry kilns will be required to handle the mill output, three of these being now almost completed. The kilns are of the North Coast type, and will occupy a total space of 720 x 120 feet with stone foundations, brick walls and concrete roofing. The Western Canada Power Company at the time plans were prepared for this mill, were supplying the power for 11 motors aggregating 335 h.p. in connection with the E. H.

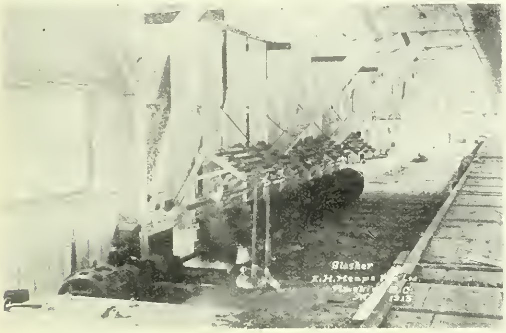


Fig. 1 Motor direct-connected to slasher.

Heaps & Company's new planing mill at Cedar Cove, Vancouver, B.C.

The power at Ruskin is also bought from the Western Canada Power Company, who have erected a fireproof sub station on the company's mill premises. The power is received here from the generating centre, about 7 miles distant, at a potential of 12,000 volts. It is controlled by a hand operated automatic overload G.E. oil circuit breaker, mounted on an iron frame work. From here it passes to three 12,000/400 volt Allis. Chalmers. Bullock o.i.w.c. transformers of 333 1/3 kw. capacity each. Space is also provided for another bank of three transformers of the same capacity. The power is transmitted from the transformers to the main switchboard in the mill by temporary mains consisting of three 1,000,000 c.m. cables.

The main switchboard is of special design and was built at the mill. It consists of four panels of 2-in. blue Vermont marble. Two panels are each 24-in. wide and two are 30 in. wide, giving a total width of 9 ft. The board stands 7 ft. 6 in. high and about 5 ft. from the outside wall.

On the first panel, which is 24 in. wide, are mounted:—one 7½-in. Wagner, 110 volt, a.c. voltmeter; one 7½-in. Wagner, 500 a., a.c. ammeter; one 400a. 250 v., d.p.d.t. knife switch; eight 50a. 110 v., d.p.s.t. knife switch. On the second panel, also 24-in. wide, are mounted:—one 7½-in. Wagner, 600 v., a.c. voltmeter; one 7½-in. Wagner, 2000 a., a.c. ammeter; one 2000a. t.p.s.t., type E. "Condit" oil switch. On each of the two 30-in. panels are installed two 500a., t.p.s.t., automatic, "Condit" oil circuit breakers.

There are at present four distributing panels. Panels Nos. 1 and 2 are each controlled by one 500a. circuit breaker on the main switchboard. Panels 3 and 4 are controlled from one 500a. circuit breaker, leaving one circuit breaker for future extensions to the mill.

Panel No. 1 consists of the following fuse blocks,—2 sets of 401-600a; 2 sets of 201-400a; 4 sets of 61-100a; 8 sets of 31-60a; 2 sets of 0-30a. This panel is of 1-in. marble, is 8 ft. 8 in. long and 2 ft. 6 in. high and completely enclosed in steel cabinet. All the fittings on same are polished copper and back connected. There are at present controlled from this panel the following motors, all belt connected to their machines,—

H.P.	R.P.M.	Type	What Drive
300	900	Slip ring	10-ft. Allis band mill.
40	1200	Squirrel cage	54-in. jump saw.
30	1200	Squirrel cage	Log haul.
20	1200	Squirrel cage	Conveyor.
15	1200	Squirrel cage	Conveyor.
10	1200	Squirrel cage	Roll case.
10	900	Slip ring	Conveyor.
7½	1200	Squirrel cage	Trout set works.
7½	1200	Squirrel cage	Canting gear & rock saw.
5	1200	Squirrel cage	Filing machinery.

Panel No. 2 is also of 1-in. marble, 4 ft. 8 in. long and 2 ft. 6 in. high. Fuse blocks are polished copper and back connected and consist of the following sizes:—1 set of 401-600a; 1 set of 101-200a; 4 sets of 61-100a; 2 sets of 31-60a. The following motors are at present controlled from this panel; the first two machines are direct connected,—

H.P.	R.P.M.	Type	What Drive
200	1200	Squirrel cage	84-in. Allis-Chalmers edger.
75	860	Squirrel cage	10-48" slasher saws & chains
20	1200	Squirrel cage	Transferer.
20	1200	Squirrel cage	Transferer.
10	860	Slip ring	Conveyor.

Panel No. 3 is of 1-in. marble and front connected; fuse blocks are as follows,—1 set of 401-600a; 3 sets of 101-200a; 2 sets of 61-100a; 4 sets of 31-60a. The following motors are at present controlled from this panel; the saw trimmers are direct connected,—

H.P.	R.P.M.	Type	What Drive
150	850	Squirrel cage	7-ft. Mershon resaw and transfer chain.
50	720	Squirrel cage	24-in. saw trimmers and transfer chains.
20	1800	Squirrel cage	2 cut-off saws.
15	1200	Squirrel cage	Roll cases.
10	1160	Slip ring	Conveyors.

Panel No. 4 also of 1-in. marble and front connected,

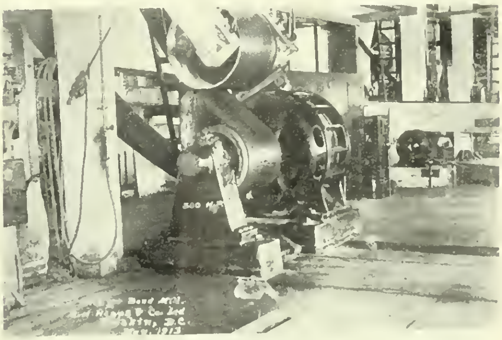


Fig. 2.—Motor drive for band mill.

contains,—4 sets of 201-400a; 7 sets of 61-100a; 2 sets of 31-60a; 1 set of 0-30a. The following motors are at present controlled from this panel; the sizer and pony edger are direct connected,—

H.P.	R.P.M.	Type	What Drive
50	900	Squirrel cage	Stetson & Ross sizer.
40	1200	Squirrel cage	Roll cases.
30	1200	Squirrel cage	Roll cases.
30	1200	Squirrel cage	Roll cases.
30	1200	Squirrel cage	Fan.
20	1800	Squirrel cage	Pony edger.

20	1200	Squirrel cage	Roll cases
20	1200	Squirrel cage	Sorting table
10	1200	Squirrel cage	Conveyor.

The Planing Mill

The planing mill, which is situated some distance from the saw mill, is supplied direct from the 440 volt busbars in the sub station. Current is controlled by an 800a knife switch and fuses. The cables are installed under the gangway to the planing mill, entering the mill through an 800a knife switch and fuses to a slate panel 8 ft. long and 4 ft. high, front connected and containing the following fuse blocks.—1 set of 401-600a; 1 set of 201-400a; 4 sets of 101-200a; 2 sets of 61-100a; 4 sets of 31-60a; 2 sets of 0-30a. The following motors are connected from the panel; the matchers, moulder, sticker and cut-off saws are direct connected.—

H.P.	R.P.M.	Type	What Drive
75	860	Squirrel cage	Blower fan.
50	1200	Squirrel cage	6 x 15 matchers
40	1200	Squirrel cage	6 x 15 matchers.
10	1200	Squirrel cage	Berlin resaw.
30	860	Squirrel cage	15-in. wood moulder.
20	850	Squirrel cage	12-in. sticker
10	1200	Squirrel cage	Rip saw.
5	1200	Squirrel cage	Grinding machinery.
3	1800	Squirrel cage	Swing cut-off saws.
1	1800	Squirrel cage	Knife grinders.

Provisions have been made throughout to double the size of the plant. All wiring for power and lights is in conduit, and is carried beneath the floor wherever possible to avoid interfering with machinery repairs or alterations. Distribution panels are placed at the most economical points, viz.—close to the largest motor or group of largest motors that each panel controls. The lighting is 110 volt a.c. multiple. Eight distribution panels are centrally located on the different floors, each controlled by a knife switch and fuses on the switchboard of the lighting panel. Each circuit is controlled by a knife switch and fuses and 8-16 c.p. lights is the maximum per circuit. Over sorting tables, trimage edger, slasher, trimmer and live rolls, lights are placed in an inverted trough painted white. The mill having been whitewashed throughout, very little light is absorbed by the walls. The efficiency of the lights is thus greatly improved.

All motors in the sawmill are of Allis-Chalmers-Bullock make. The band mill motor is a three-bearing type. The

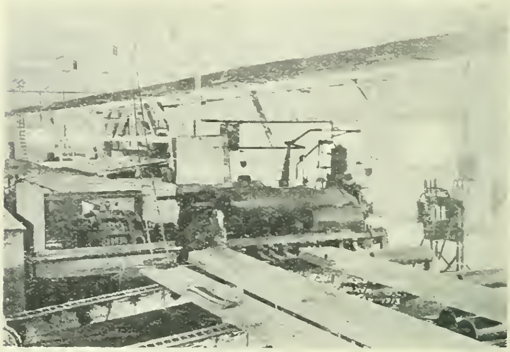


Fig. 3. Motor direct-connected to edger.

motors in the planing mill over 5 h.p. are of Allis-Chalmers make. Starters are provided with no voltage release. Motors of 5 h.p. and below were supplied by the Canadian General Electric Company. Every single motor in both mills is protected by a Conduit oil circuit breaker.

Mr. Louis Brodeur, electrical engineer and contractor, of Vancouver, had charge of the complete installation. Mr. G. Lewthwaite, steam and electrical engineer, is now in charge of the steam and electrical plant.

Sarnia's Splendid New Electric Equipment

Following the Fire of 1911, a New Power-house and New Machinery Places this Plant in First Rank

The Sarnia Gas & Electric Light Company was organized in 1884 to supply artificial gas for lighting and in 1893 electric lighting was added. The business in the early days was exceedingly small; for instance, in 1892 there were only

Fig 1 New power-house, Sarnia, Ont.

150 gas meters. The original electric generator was only 50 kilowatts.

Under the progressive and liberal management of Mr. W. Williams and the intelligent support he received from his directors, the business quickly developed, requiring constant additions to the power plant. In 1899 the street railway, owned by a separate company, was electrified, to be operated twenty four hours daily and seven days a week. This company contracted to supply the electric current required for its operation. In 1908 natural gas was delivered at Sarnia from the Tilbury gas field. Arrangements were immediately entered upon to deliver the same to the citizens for all purposes of heat and light at prices that are almost negligible when convenience and comfort are considered. The business kept up a constant increase with the necessary additions to the power plant.

In 1910 the generating plant became taxed to its capacity once more. Although the service was good the style of plant had entirely outgrown itself, and it was decided to modernize the plant as well as increase its capacity. The services of Mr. J. O. B. Latour, Toronto were retained as consulting engineer, and contracts were soon closed for direct connected generator units, including a low pressure turbine. The belt transmission from a Jack shaft was to be

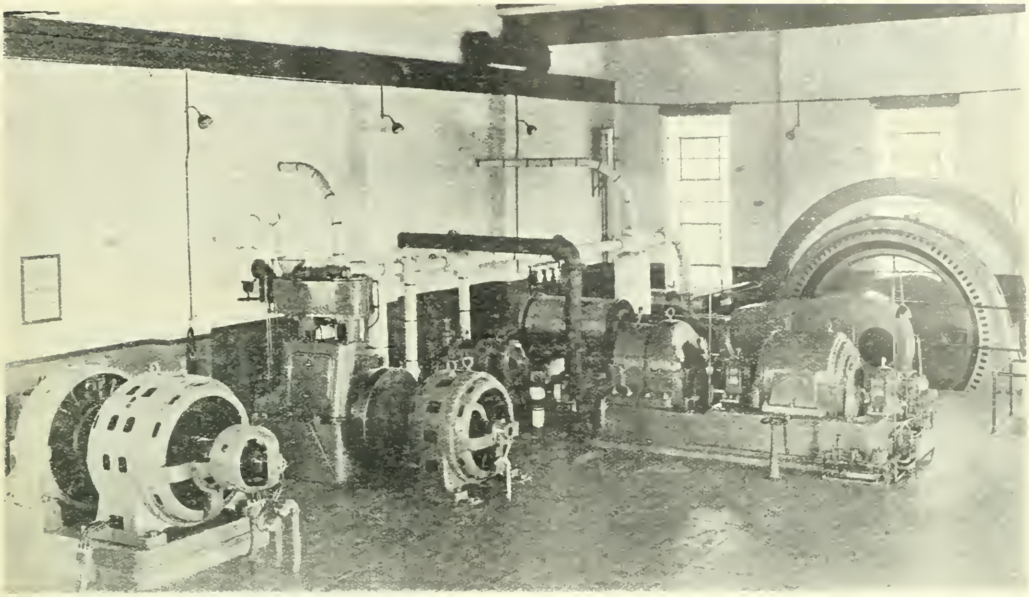


Fig. 2 General view of new plant of the Sarnia Gas and Electric Co.

eliminated. Work was also commenced to enlarge and improve the boiler house.

On the 27th of June, 1911, the plant was wiped out by fire and both lighting and street railway service crippled. This resulted in the electric lighting plant being out for the first time since it first started up. A direct connected railway engine-generator unit was secured and erected in the gas plant and as the boilers were not damaged a partial street railway service was resumed on the 12th of July. The new main generators, too, fortunately were not yet installed, so escaped damage. The low pressure turbine was erected temporarily and operated direct from the boilers through the medium of a pressure reducing valve re-establishing the lighting service on the 25th of July. If the company had not had this new machinery on hand the electric lighting service would have been crippled for a much longer time as it was impossible, at that time, to buy any electrical apparatus and secure delivery on short notice.

This experience caused the company to decide that an electric station for public supply must be fireproof. Plans were immediately prepared by their consulting engineer, and the present building constructed. The building is about 90 x 90 ft., divided into two parts, vertically, one side reserved for boilers and their auxiliaries, while the other half has a basement ten feet deep which is used for general repair shops, condensers and other necessary auxiliary apparatus. The upper section of the power house contains all the generating apparatus. The floor is constructed of I beams with arch tiles and surfaced off in concrete. All the steel is fully fireproofed. It is designed for a safe load of 450 lbs. net per square foot. This is found to be ample for all the different motor and turbo-generator sets without foundations, the reciprocating engines, only, requiring foundations, thus leaving nearly the entire basement for useful occupation. All the floors are concrete.

The basement walls are concrete 24-in. thick, and the remainder of the walls are hard brick of a red color, 18 in thick stiffened with pilasters, spaced about 11 ft. centres. The roof is reinforced concrete and suitably covered to prevent condensation. It is supported by steel trusses. The roof is low at the centre where all the water is conducted to the hot well by a suitable pipe. This pipe is arranged to act as a ventilator for the hot well which also received all drip connections, thus preventing excess moisture in the room. This is an important factor in electric plants. The interior walls of the generating room are all plastered with lime mortar which gives the room a good finish as well as increased lighting. The windows are fitted with steel sash and wire glass. The only wood is in the four doors, but these, owing to the isolated situation of the plant, are not interfering with the fireproof regulations of the underwriters.

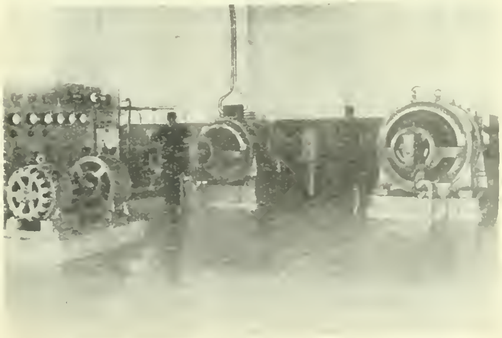


Fig. 3--Another corner, showing part of switchboard.

There are at present five horizontal return tubular boilers 72 in. diameter by 18 ft. long, except one which is 14 ft. [illegible] have 86—3½ in tubes making a total of 750 boiler horsepower. There is room for two more similar boilers. The working pressure is 140 pounds. The room [illegible] ample

height to install any style of boiler. The fuel is natural gas, but the furnaces are so designed that coal can be used without having any changes other than fuel to make. This is an important part in such a plant. There is a railway siding on the west side where a large quantity of coal can be cheaply unloaded, convenient for the firemen to pass on to the firing floor. There is a 24 in. concrete pipe connecting the cold water well with the River St. Clair. There are duplicate boiler feed water pumps of the Duplex type with outside packed water plungers. Although the boiler feed water is good, there is a water purifier designed by their consulting engineer. The water is first heated by waste steam in an open type of heater where sal-soda is added; this solution is then passed on to a reaction chamber and finally filtered; it then passes to a Worthington liquid weigher, recorded, and delivered ready for the boiler pump. All regulation is automatic.

Alternating current is generated at 2300 volts, 60 cycles and three-phase. The generating apparatus consists of one cross compound Wheelock engine 19 in. x 38 in. x 42 in., 100 r.p.m., direct connected to a Swedish General Electric 375 kv.a. generator.

One Goldie & McCulloch Company vertical compound, quick revolution, forced lubrication, engine direct connected to a Swedish General Electric 188 kv.a. generator, 450 r.p.m. One Rateau-Wait low pressure turbine direct connected to a Swedish General Elecerie 500 kva. generator, 3600 r.p.m. This all makes a total normal generating capacity of 1063 kv.a. with 25 per cent. overload capacity for three hours. There is also 50 kw., d.c. turbo-generator capacity at 125 volts. This is the first low pressure turbine installed and built in the Province of Ontario. Goldie & McCulloch Company, Galt, were the makers. It receives the exhaust of the two main engines or direct from the boilers through a pressure reducing valve. There is ample reserve floor space for a 1500 kw. horizontal turbo-generator.

The Westinghouse-Leblanc condenser, which is the first one installed in Canada, is located directly under the turbine, and maintains 28 in. or more of vacuum according to the initial temperature of the condensing water and load. The water and air pumps are driven by a Westinghouse turbine. The main engines exhaust into a 48 in. x 72 in. receiver, and can exhaust from there into a Goldie & McCulloch independent

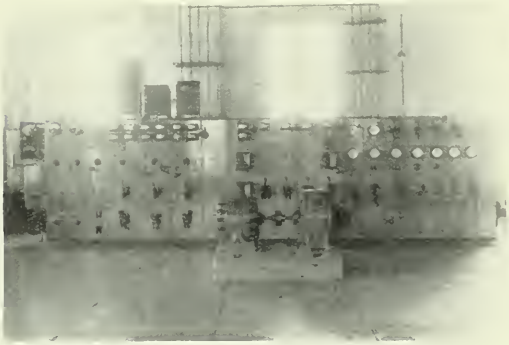


Fig. 4.—Switchboard, Sarnia Gas and Electric Co.

condenser, which is more convenient and economical at small loads.

There are two 25 kw. Westinghouse turbo-exciter and one 15 kw. Westinghouse motor exciter sets to supply exciting current at 125 volts.

The direct 600 volt current for the street railway is generated by two Swedish General auto-synchronous motor sets of 150 kw. and 300 kw. capacity respectively. The switchboard is complete in every respect; the lighting part was supplied by the Canadian General Electric Company, and the railway part by the Swedish General Electric Company. The panels are blue Vermont marble on pipe frame work. The board is located 8 ft. from the wall and as there are three large windows behind it, the lighting during day light as well as space are all that can be desired. The instruments consist of all the necessary ampere, volt and watt meters, curve volt, watt for total load, watt for street railway load meters, synchronizing and frequency indicator and Tirrill regulator. The arc lighting is controlled by two 50-light constant current auto transformers.

The lighting of the entire station is all that can be de-

Mr. William Williams.

sired. All electric cables and wiring in the plant is in metallic conduits laid in the surface of the floor or walls.

There is a 10-ton hand travelling crane made by Herbert Morris & Basterd, Limited, Empress Works, Loughborough, and supplied by George Tod, Toronto, which is perfect in every respect.

The citizens of Sarnia have recognized, by a constant increase of business, the efforts of the company in building such an up-to-date plant, which is an ornament as well as a guarantee of good reliable service. The officers are, Thomas Kenny, President; W. B. Collins, Wm. Storey, David Milne, J. H. Jones, Directors; Wm. Williams, Manager; J. B. Williams, Secretary-Treasurer; J. E. B. Phelps, Chief Engineer; A. G. Wheeler, Electrician. This organization is a guarantee of continuous good service and liberal treatment.

The town of Outremont, P.Q., have decided on a scheme of lighting, designed by Professor L. A. Herdt, their consulting engineer. For the present only a portion of the scheme will be carried out. Last year the council awarded a contract to Mr. G. M. Gest to construct a dual conduit for the town and for the Bell Telephone Company, and this is to be utilised for the new lighting, which will comprise 500 lamps out of the 1,100 for which the complete plans provide, which will light the main streets of the city. The standards have been specially designed by Professor Herdt, and will be surmounted by a single tungsten light.

Developments in Hydraulic Turbines

Present Practice in Design and Construction—Marked Advance in Efficiency—A Matter of Prime Importance In Canada

By Mr. H. Birchard Taylor, M. Am. Soc. M. E.

The High Capacity Runner and the Vertical Single Runner Turbine (continued)

In referring to the capacity of a runner, there is a certain relation between head, speed and power output which is best expressed by a theoretical characteristic known as "specific speed" (N_s). This characteristic was first introduced by German engineers. It gives us a means of comparing the relation between the conditions of speed, head and power of a runner in one installation with the same conditions relative to a runner in a totally different installation. This comparison is made after the conditions governing the design of both runners have been reduced to a common base, viz., specific speed.

The specific speed of a runner may be defined as the speed at which any runner will operate when it is reduced to such a size that it will develop one horse-power when operating under a head of unity. The numerical value, expressed in the metric system, of the specific speed of any runner may be found by first calculating the speed and power output of the runner under consideration for one metre head, and then mathematically reducing the runner in size until it will deliver one horse-power. The speed of this reduced runner, when operating at its point of maximum efficiency is its rated specific speed, and this speed is expressed in the formula

$$N_s = \text{r.p.m.}\frac{\sqrt{\text{h.p.}}}{\sqrt[4]{h^5}}$$

the quantities being expressed in the metric system. For converting this to the foot-pounds system of units, the formula is

$$N_s = 4.45 \times \text{r.p.m.}\frac{\sqrt{\text{h.p.}}}{\sqrt[4]{h^5}}$$

in which the horse-power and head are expressed in the foot-pounds system, while the N_s remains in the metric system. The specific speed as calculated from this latter formula is the one generally used. In figuring the specific speed of any turbine having more than one runner, the horse-power used in the formula, of course, is the output of each runner.

An examination of the formula will show that for a given r.p.m. and head, the h.p. output is proportional to the square of the specific speed; also that for a given head and h.p., the r.p.m. of a turbine is proportional to the specific speed.

Five years ago a specific speed of 275 was considered to be quite high, while to-day a specific speed of 400 is secured together with as high a maximum efficiency as was previously secured with a specific speed of 275. Thus, to-day it is possible with very high efficiency to secure for a given condition of head and power, and with the same maximum efficiency, a speed in the neighborhood of 50 per cent. greater than was possible five years ago; or, for a given head and speed, an increase of approximately 100 per cent. in the horse-power can be obtained.

With the highest specific speed which could be secured five years ago, the resulting r.p.m. for a vertical shaft, single runner turbine for low heads was, in a great majority of cases, such as to make the cost of both the turbine and generator prohibitive. During the last two years, however, with runners of increased specific speed, a much higher rotational speed can be secured for the same head and power, so that the turbine and generator designs have become thoroughly practical and economical.

Although it is true that the rotational speed secured in such a turbine is low when compared with the speed secured with turbines of the same specific speed and having two or more runners, there are many mechanical advantages involved in the use of the single runner vertical turbine for low heads which more than over-balance the increased cost of the generator.

Prominent Low Head Plants

The following are among the recent prominent low head plants for which the single runner vertical shaft turbines have been adopted:

Appalachian Power Company, New River, Virginia.
- Development No. 2, four 6,000 h.p. units, head 49 feet; speed 116 r.p.m.
- Development No. 4, three 3,500 h.p. units, head 34 feet; speed 97 r.p.m.
- These turbines hold the highest record of efficiency ever obtained, namely 93.7 per cent.

Mississippi River Power Company, Keokuk, Iowa:
- Present installation fifteen 10,000 h.p. units, head 32 feet, speed 57.7 r.p.m.
- Ultimate installation thirty units.

Georgia-Carolina Power Company, Stevens Creek, Georgia:
- Present installation, five 3,125 h.p. units, head 27 feet, speed 75 r.p.m.
- Ultimate installation, ten units.

Alabama Power Company, Lock No. 12, Coosa River, Alabama:
- Present installation, four 17,500 h.p. units, head 68 feet, speed 100 r.p.m.
- Ultimate installation, six units.

Cedars Rapids Manufacturing & Power Company, St. Lawrence River, Canada:
- Present installation, twelve 10,800 h.p. units, head 30 feet, 55.6 r.p.m.
- Ultimate installation, eighteen units.
- These will be the largest turbines in the world in point of dimensions, and will each weigh approximately 1,250,000 pounds.

Laurentide Company, Limited, Grand Mere, P.Q., Canada:
- Present installation, six 20,000 h.p. units, head 76 feet, speed 120 r.p.m.
- Ultimate installation, ten units.
- These will be the highest powered single runner vertical turbines in the world to date.

Northern Ontario Light & Power Company, Cobalt, Canada:
- Present installation, two 1,500 h.p. units, head 30 feet, speed 150 r.p.m.

Turners Falls Company, Turners Falls, Massachusetts.
- Present installation, three 9,700 h.p. units, head 54 feet, speed 97.3 r.p.m.

Had these plants been built five years ago, it would have been impossible to install vertical shaft single runner units of the same capacity, owing to the low speed and the resultant size of turbines and generators. For the same capacity, it would have been necessary to install turbines with more than one runner, or if single runner vertical shaft turbines were used, the capacity of each would necessarily have been considerably less than that of the turbines adopted, owing to the

[illegible] which it would have been necessary to deal.

Now consider the disadvantages of the multi runner type of turbine.

Disadvantages of the Multi-Runner

1st. Two or more sets of gate mechanisms are required.

2nd. Equal gate openings on all runners are difficult to obtain at all degrees of opening, owing to the lost motion or torsional deflection in the gate operating shafts.

3rd. One or all of the gate mechanisms are completely submerged and are not accesible until the unit is shut down and the wheel-casing is drained. Therefore, the breakage of a gate connection may only be detected by the falling off of the power output from the generator. In addition to this, a number of the main shaft bearings are inaccessible.

4th. When multi-runner, horizontal shaft type units are installed, it is frequently necessary to have the generator floor below high tailwater level.

5th. It is often impossible to place the runners sufficiently far below the headwater surface to avoid the formation of vortices and the drawing of air into the turbines. This condition frequently impairs speed regulation as well as efficiency, and invites corrosion. When multiple runner horizontal units are set in enclosed casings, this trouble may be avoided; but another disadvantage then appears, since there is a loss of head as the water passes each wheel and draft chest, and the runners last in line have in some cases been found to be operating under a considerably reduced head.

6th. In the case of a vertical turbine having more than one runner, the depth and, consequently, the cost of substructure of the power house is necessarily much greater than in the case of a vertical shaft single runer turbine.

7th. The cost of erection and of dismantling for repairs in the case of multi-runner units of either the vertical or horizontal type is considerably more than in the case of the vertical shaft, single runner type.

8th. The opportunity for lost motion in the connections between the governor mechanism and the wicket gates is, of course, greater the larger the number of runners used with the corresponding gate mechanisms. Consequently, in the case of multi-runner wheels, there is a proportionally greater opportunity for hunting to develop in the operation of the governors than in the case of single runner turbines.

9th. In any type of turbine having two or more runners in which the runners discharge against each other into a common draft chest or chests, there is considerable loss in efficiency due to interference of discharge as already explained, unless the distance between runners and, therefore, the length of the turbine and the cost thereof, is greatly increased. The higher the specific speed, the higher is the discharge velocity from the runner buckets and, as the loss in the draft chest or tube is proportional to the square of the velocity, the loss in efficiency increases with the specific speed. It necessarily follows that in the case of high specific speed wheels, great care must be exercised in properly designing the draft chests and draft tubes. The avoidance of sharp bends in the immediate neighborhood of the runner discharge is an advantage obtainable with the single runner vertical turbine.

Advantages of the Single Runner

Among the principal advantages of the single runner unit are the following:

1st. Only one gate mechanism is required, and this is located above the head cover of the turbine and is accessible at all times for inspection while the unit is in operation. The only parts of the turbine that are submerged are the runner and the guide vanes. Repairs can be made to the gate operating mechanism without dismantling the turbine.

2nd. Owing to the fact that only one gate operating mechanism is used, involving a small number of parts, the chance for breakage is reduced to a minimum, and lost motion and deflection in the governor engine connections are avoided.

3rd. It is possible to secure in a single runner unit an ideal draft tube of long tapering section, without an obstruction or sudden turn. Therefore, with this type of wheel it is possible to use runners of the very highest specific speed, as the draft tube can be designed to convert the velocity at the discharge from the runner buckets into effective head with small degree of loss.

4th. With a single runner vertical unit, it is possible to mold in the concrete a spiral turbine casing similar in design to the cast iron spiral casings used in connection with high head turbines. It would be impracticable to prepare spiral casings for vertical or horizontal turbines having two or more runners, for obvious reasons. In a single runner turbine operating in a spiral casing, the water is directed to the runner at uniform velocity around its entire circumference, producing more uniform operation and higher efficiency thereby. In the case of the multi-runner vertical or horizontal wheels, however, it is necessary to set these wheels in open flumes or cylindrical casings, in which case the water is not guided uniformly to the runner. Consequently, the approaching water is in a more or less turbulent state from eddies and whirls. In order to eliminate excessive loss in efficiency due to these eddies and whirls, it is essential to keep the velocities extremely low in the flume by increasing the dimensions of the flume, and therefore the distance between wheel-centres.

5th. It is very often possible with turbines of the single runner vertical shaft type, to locate the runner and gate mechanism above high tailwater level, so that after the closing down of the head gates and drainage of the wheelpit, an attendant may examine all parts of the turbine without first having to pump out the wheel-chamber.

The theory of the flow of water through runners as derived from low specific speed wheels is not applicable, without modification, to the design of high specific speed runners, on account of a number of new factors which must be considered. Low speed wheels are such as are usually applied to high head turbines. The runners installed in the various units at Niagara Falls are examples of low and moderate speed types.

Exact data regarding the performance of projected turbines of large size, when the specific speed is high, can be most easily and accurately obtained through tests on a model at the Holyoke flume.

An Efficiency of 93.7%

It may be of interest to note that the experimental runner tested at Holyoke for the two 17,000 horse-power turbines recently installed in the plant of the Pennsylvania Water & Power Company, at McCall Ferry, Pennsylvania, gave an efficiency of 90.62 per cent. The actual efficiency of the large units, as approximated from the power output, is in the neighborhood of 87.5 per cent, showing a loss of approximately 3 per cent. The McCall Ferry turbines are of the vertical shaft, two-runner type, each runner discharging downward into an independent draft tube, which is the best possible arrangement for a turbine of this type. It was necessary, however, in the case of the draft tube below the lower runner to make an extremely sharp turn so as to avoid excessive excavation, and both draft tubes were so modified on account of structural conditions that the distribution of areas is hydraulically defective. The turbines are installed in open flumes of rectangular dimensions. The difference in efficiency, therefore, between the model runner and the large turbines may be easily attributed to loss due to unfavorable hydraulic conditions in both draft tubes, and particularly to the sudden turn in the lower tube, and also to the usual losses which occur in an open flume setting.

In the case of the Appalachian turbines, which are of the vertical, single runner type, having concrete spiral cases and

ideal draft tubes, very exhaustive efficiency tests were made on two of the wheels, measuring the water by means of a carefully constructed weir 82 feet across the crest. The average efficiency secured in the two wheels tested was found to be 93.7 per cent. The model runner showed at Holyoke a maximum efficiency of 89.68 per cent. Consequently, the large units in place showed 4.02 per cent. in excess of the maximum efficiency secured in the model runner.

This comparison clearly indicates that the vertical single runner turbine with a spiral casing is more efficient than the experimental wheel, while the efficiency of the vertical two-runner turbine operating in an open flume is considerably below the efficiency of the experimental setting; and therefore the difference in efficiency between the vertical single runner turbine and the two-runner vertical turbine is a very appreciable amount.

There have been quite a number of horizontal two-runner units, having central discharge chests, which have been carefully tested in place. These units seldom show efficiencies above the experimental models. The only cases in which large turbines of this type have exceeded the efficiency of the experimental model have been in units of very high power having carefully designed draft chests, or in instances where the specific speed was not high; or where the experimental models used in the comparisons were tested in inefficient settings.

The advantages enumerated in favor of the single runner vertical wheel have made that type of turbine most desirable for low head installations and also for many high head developments, and undoubtedly this type of unit will be very generally adopted in the future.

Speed Regulation

In addition to considerations of efficiency, deterioration and mechanical arrangements of turbines, the question of speed regulation is of great importance where turbines are employed for driving alternators. Speed regulation is obtained by means of a governor driven from the turbine shaft, consisting primarily of a governor head containing flyballs controlled by springs and connected through a pilot valve to the main governor valve. At normal speed the flyballs hold the governor valve in its mid-position, but for any change in speed the flyballs move the valve, admitting pressure through a suitable number of relay valves to an operating cylinder so that the turbine gates are adjusted to suit the new load and to obtain the normal speed.

Some of the chief considerations in connection with speed regulation are:

1st. Sensitiveness of the governor head involving quick response to sudden changes of speed and also response to slight changes of speed.

2nd. Steadiness or stability of action. This quality is an important one and involves freedom from unnecessary gate movements or movements occasioned by conditions other than changes of load on the unit. It is not only necessary for a governor to respond to changes of load, but it is equally important that it shall not act when there is no change of load. The continual motion and vibration of the turbine gate mechanism produced by unstable governors is a source of wear and rapid deterioration of the gate mechanism which in turn accentuates the lack of stability and is very objectionable. In older types of governors this tendency was usually overcome by the use of a dashpot to damp such motions, but the use of a dashpot for this purpose renders the governor sluggish and impairs its action.

3rd. Power of governor. For large units a large amount of power is required to actuate the turbine gates. This power may be obtained from a delicate governor head by the use of a series of relay valves controlled primarily by a small pilot valve attached to the governor head. In order to obtain sufficient fluid to move the operating piston, the main valve on the operating cylinder must be large and heavy, so that with a large unit either a considerable number of intermediate valves between the pilot valve and the main valve must be used, or else the governor head itself must be given a considerable amount of power. The same result could perhaps be accomplished by the use of high pressures in the governor system, but the use of such pressures has proved very unsatisfactory in practice and has been abandoned in favor of moderate pressures. Since time is required for sufficient fluid to flow through each valve to move the next valve in series, increase of power by such means is limited by the speed of action required. The best solution seems to be in the use of flyballs having a weight and power corresponding in order of magnitude to the turbine which they must control. Such increase in power in the flyballs involves no sacrifice in sensitiveness, since the governor head is mechanically connected to the turbine shaft and is forced to respond immediately to any change in speed of the unit. The sensitiveness will, in fact, be increased by the use of heavy flyballs, since the retarding effect of friction can be made relatively less.

4th. Reliability in operation. It is recognized by engineers of experience that delicate and complicated mechanisms should be avoided, and all machinery made to stand severe service and to be as nearly fool-proof as possible. For this reason governors in important stations should be of as simple and rugged a design as possible. The effect on a large and heavy governor of accidental conditions, such as the presence of grit in the governor fluid or sticking of the governor parts, will be slight as compared with the effects on a delicate piece of apparatus.

5th. The pressure system used was formerly divided into a separate pumping equipment for each unit in a station. This has been abandoned in favor of a single pumping system supplying the entire station. This change has greatly reduced the cost of attendance and has improved the continuity of service. The open system of governing is now being used in which oil or water for the governors is pumped from an open tank and no pressures less than atmospheric are used at any point in the system. This change avoids troubles caused by air collecting in the pipes or pumps or the breakdown of oil under high vacuum.

6th. Hand control. Another recent improvement is in the nature of the hand control used for the operation of the turbine gates. Originally the hand control of a turbine was accomplished by mechanical means through trains of gears. The mechanical efficiency of such a mechanism is so low that the time required to close the gates of a large turbine by such means is prohibitive. The mechanical hand gear was gradually replaced by a hand wheel incorporated in the design of the governor, controlling the turbine gates by oil pressure through the main valve of the governor. This arrangement, however, although it has been recently used by a number of the standard governor builders, is subject to the objection that should the governor valves be dismantled for repairs the turbine must be shut down, and it is poor engineering to dispense with the services of the turbine for the sake of a governor valve. The best method of hand control now adopted for large units, seems to be in a separate device, entirely independent of the governor and placed at a convenient point, and so designed as to admit oil from the central pumping system directly to the turbine operating engine. A restoring mechanism connection from the turbine gates maintains these gates in a position corresponding to the position of the handwheel. By this means it is possible to move by hand the gates of the turbine through their entire range in approximately ten seconds of time. Except for units of very large size, a small hand operated plunger pump may be supplied in connection with the operating stand by means of

which it is possible to create pressure for the movement of the gates in the event that the central pumping system is temporarily out of service.

7th. The mechanism of the modern governor itself has been reduced to a few comparatively simple operations. Certain compensating devices are required to restore the governor valves after the required gate movement has been produced and also to restore the speed of the turbine to the required value after the water column in the penstock, turbine casing and draft tube has had time to be accelerated or retarded to its new value. The governor should also have adjustments, so that the change in speed from full load to no load conditions may be fixed to suit the parallel operation of alternators, also to adjust the time of action of the governor to suit the length of the velocities in the water passages and an attachment for changing the normal speed of the turbine. Modern governors are also fitted with motors by means of which the speed of the turbine can be adjusted from a distant point, such as the switchboard, this device being used in synchronizing the unit.

The above points cover all the features which can be controlled in the design of the governor itself. The speed regulation of a unit, however, depends on several other factors which are invariably of greater importance than the action of the governor itself; these are the length of and velocities in the penstock and draft tube, as well as the length of the water column in the turbine casing itself; also the "flywheel effect" of the rotating masses of the generator and turbine.

A perfect governor will be unable to produce a speed regulation better than that permitted by the factors just mentioned. These factors are controlled by the design of the power development as a whole, so that the actual speed regulation obtained is only affected to a limited extent by the construction of the governor itself. Properly, all of these factors should be considered together.

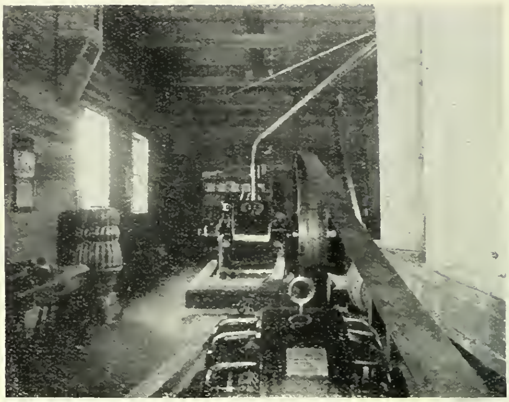
In a majority of the large installations recently undertaken, turbine governors have been designed and constructed by the builders of the turbines, thus producing a governor suited to the exact conditions of each turbine and avoiding the division of responsibility which has so often proved to be a source of annoyance. The better appreciation of the factors entering into governor problems has resulted in greatly improved speed regulation which, when taken in connection with valuable improvements in the mechanical design of the governor, has removed this important auxiliary from the class of necessary evils and placed it in that of reliable machinery.

New Plant at Grenfell

Some two months ago the town of Grenfell placed their first electric plant in operation. The plant consists of a Ruston-Proctor suction gas engine, 60 h.p. capacity, belt connected to a 30 kv.a., a.c. generator and exciter. The equipment was supplied and installed by the British Canadian Engineering & Supply Company, Winnipeg.

The streets of Grenfell are illuminated by 40, 100 watt series tungstens and there are already nearly 100 houses connected up, which is very encouraging for the short time the plant has been in operation. For the present the plant is run from 3.30 p.m. to 8 a.m., that is 16½ hours, and the amount of pea coal consumed daily is about 600 pounds.

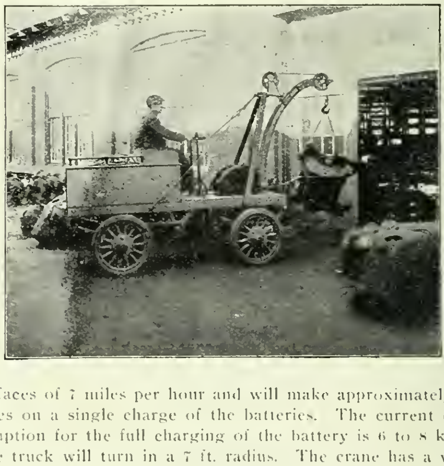
Mr. Geo. Parley, electrical engineer of the town, states that the plant is operating very satisfactorily and only requires attention about every three hours. The lighting rates are 20c per kw.h. with a discount of 20 per cent. if accounts are paid within 10 days. The total cost of the plant, including the distribution system, was about $15,000. Grenfell is a splendid example of the progressive western town where they appreciate that the expenditure of a comparatively small amount of money in an electric light plant is one of the best investments a town can make.



Producer gas-electric plant at Grenfell, Sask.

A Battery Crane Truck

The truck illustrated herewith, manufactured by the General Vehicle Company is what is known as the battery crane truck. This type of truck, as well as their regular battery truck and electric trailer, have met with wonderful success during the last two or three years, as of the 2,000 lb. type illustrated herewith there are some 300 in use. The different kinds of truck mentioned may be called refinements of the simple freight truck, only with functions varying somewhat in each case. The applications of the battery truck crane are in general, hoisting, hoisting and carrying on the hook, and towing trailers. In the illustration the crane is shown handling a heavy casting. This truck has a speed on hard level



surfaces of 7 miles per hour and will make approximately 25 miles on a single charge of the batteries. The current consumption for the full charging of the battery is 6 to 8 kw.h. The truck will turn in a 7 ft. radius. The crane has a wide radius being movable through a horizontal angle of over 180 deg. The rapidity with which heavy material can be moved with an electric truck results in an economy of time which is unbelievable to one who has not seen this equipment in actual operation. The fact also that the electric occupies small space and can be driven anywhere adds greatly to its economic value.

New Steam Auxiliary Plant in Kamloops

Kamloops is situated at the junction of the North Thompson and South Thompson Rivers and is destined to be a city of considerable importance due to the splendid location near the centre of the southern part of the province of British Columbia, and its convenience both as a distributing point for a very large district and as a railroad centre where the C. P. R. and C. N. R. meet on their way to the Pacific. The present population is about 5,500 people, but the growth has been so rapid during the last two years that the city has wisely planned its municipal works with a view to largely increased future requirements.

Two years ago by-laws were passed by the ratepayers for the construction of a hydro-electric power plant on the Barriere River, together with the construction of a new steam plant and sub-station, the steam plant to serve as an auxiliary and reserve to the hydro-electric plant. Provision was also made for the construction of a new concrete reservoir with initial capacity of 1,500,000 gallons. The total amount provided for by the by-laws passed for the above requirements, was about $520,000, of which $260,000 was for the hydro-electric plant to provide, by initial installation, for 2,000 h.p.; $200,000 for the steam plant and the balance for the reservoir with certain waterworks extensions to complete the system.

The carrying out of the above works was placed under the direction of Mr. H. K. Dutcher, of DuCane, Dutcher & Co., consulting engineers, Vancouver, B.C., and up to the present time, both the reservoir and steam plant have been completed, the steam plant having been placed in service on October 28th last.

The hydro-electric plant is about half completed and will be placed in service probably by the end of next summer. It is located on the Barriere River which empties into the North Thompson about forty miles from Kamloops and the transmission line to Kamloops is also expected to supply a considerable amount of power along the route for irrigation systems.

While the initial installation at the Barriere plant will provide for only 2,000 h.p.—which, with the 2,000 h.p. at the steam plant, will give the city a total of 4,000 h.p. next year, there is a possible development at the Barriere up to 20,000 horse-power.

The steam plant and sub-station recently completed is of particular interest as it also provides for a very complete pumping plant for the city water supply from the South Thompson River, and is probably one of the most modern power plants in Canada. The contract for the main building and subsidiary structures was let to Messrs. Johnson & Co., of Kamloops, and the contract for the complete installation of the plant was given to Messrs. Charles C. Moore & Co., of San Francisco.

Mr. N. M. Hall, resident engineer for Messrs. DuCane, Dutcher & Company, supervised the construction and complete installation of the plant.

Power House

The main building is of reinforced concrete construction and is 90 feet by 75 feet ground area, divided into three parts, boiler room, near the track; the turbines and pumps with switchboard in the centre, with basement for pump well and auxiliary apparatus, and on the north side the sub-station for the hydro-electric power which will come in at 44,000 volts.

The basement under the turbines is on the same level as the boiler floor and the well for the pumps is connected by 600 feet of 16-inch main to the auxiliary pump house, at the river, where the water enters by gravity, and is lifted by vertical motor pumps to the well in the power house, this arrangement being necessary to provide means of filtering the water from a filter bed to be constructed in the near future on a site near the power house.

The fuel arrangement provides for the burning of either coal or oil in the boilers, and a siding from the C. P. R. tracks enables coal to be unloaded directly into the bunkers.

Plant Equipment

The plant equipment includes four B & W boilers, 250 h.p. each, 160 lbs. per square inch working pressure, manu-

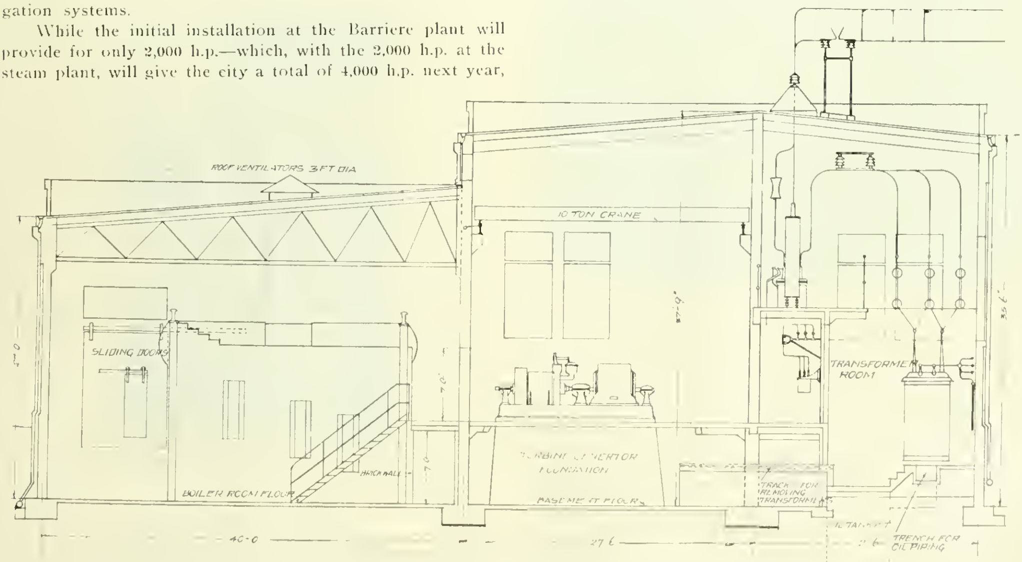


Fig. 1. Section of Kamloops new steam plant—To be supplemented by hydro electric.

factured in Scotland and supplied through the Chas. C. Moore Company. The stack is of reinforced concrete, 89 inches diameter and 180 ft. above ground level, erected by the Weber Chimney Company, of Chicago. Coal is dumped from an overhead spur into coal bunkers from which it runs by gravity into the boiler room through chutes in the rear boiler room wall. The ashes are handled by an endless chain motor-driven conveyor from hopper on boiler room level to a distance of forty feet east of boiler room; apparatus supplied by the Webster Company of Chicago, through the B. C. Equipment Company of Vancouver. There are two boiler feed pumps, supplied by the Platt Iron Works of Dayton, Ohio, through the C. C. Moore Company, and one open type Ford heater by the same firms.

The generating equipment consists of two Curtis turbo alternators, 600 kw. capacity, supplied by the Canadian General Electric Company. These operate at 3,600 revolutions per minute and are 2200 volt, three phase, 60 cycles. These units have forced oil lubrication, water-cooled bearings and electric speed changing device and over speed safety trip. The turbines exhaust into two Wheeler cylindrical surface condensers with steam turbine-driven circulating pumps and patent Edwards' air pumps. The condensers will deliver continuously from 27 to 28 inches of vacuum; they were supplied by the Wheeler Condenser and Engineering Company through the Chas. C. Moore Company.

There is one 15 kw. turbine driven exciter running at

Fig. 2. Exterior of new power building.

4500 revolutions per minute, supplied by the Canadian Gen. Elec. Company and one 20 kw. motor driven exciter running 1200 revolutions per minute, by the same firm.

Two induction motor-driven waterworks pumps, 1800 revolutions per minute, deliver 1200 gallons per minute into the new reservoir on the Beckman Addition. These will operate against a head of 260 to 400 feet.

There is also installed one Kerr steam driven waterworks pump, of the same capacity, exhausting into a Wheeler waterworks type condenser with Edwards air pump. All three pumps were supplied by the Platt Iron Works through the Chas. C. Moore Comany, the motors by the Canadian General Electric Company, and the turbine by the Kerr Steam Turbine Company, of Wellsville, N.Y. These three pumps discharge through a Simplex Venturi meter with indicating curve drawing and integrating apparatus to register the water pumped into the city mains. The suction is from a 25,000 gallon tank directly under the pumps and supplied from the river by two vertical motor-driven centri-

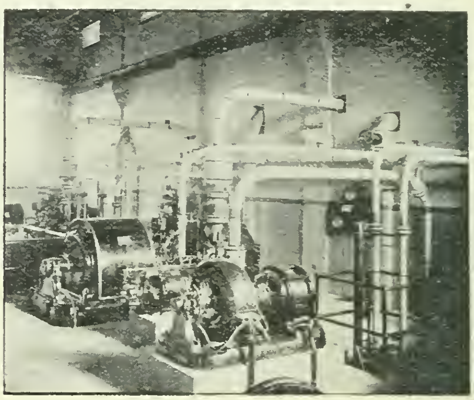


Fig. 3. Steam turbines and piping Kamloops.

fugal pumps situated in the auxiliary pump house on the bank of the South Thompson River. These pumps will discharge 1,500 gallons per minute against 50 feet head and were supplied by the Canadian General Electric Company.

The switchboard, which is of natural slate, consists of 19 panels. The board is of very neat design and when lighted up presents a very fine appearance. All high voltage wiring, oil switches and apparatus which would prove dangerous to the operators are on a structure at some distance to the rear of the switchboard and there is no apparatus actually on the panels at a potential above 110 volts. A completely

Fig. 4. View looking towards motor Pumps.

equipped station lighting panel box distributes the station lighting.

The vertical pumps at the intake are both operated from the switchboard, one by the standard hand operated starter and the other by an automatic patent started controlled by

a float switch which can maintain a predetermined height of water in the suction well of the main pump.

Behind and above the switchboard and in a closely locked room is the high voltage apparatus for the Barriere incoming lines. The transformers which will change the voltage from 44,000 to 2,200 volts, will, when purchased, be handled on their own trucks and will sit over the necessary oil and water piping. The most approved type of automatic voltage regulator will maintain constant voltage regardless of load variation and this will insure a satisfactory lighting system.

The entire station has been laid out with a view towards utmost reliability and also ease of future extension with a minimum of cost and interruption of service. The machinery and all inter-connecting apparatus is equal to the

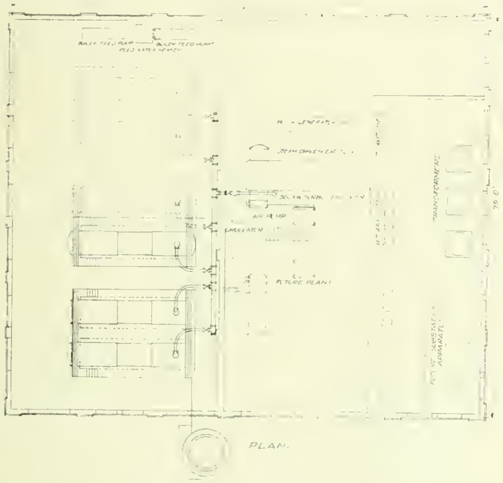


Fig. 5 Plan of steam plant—Kamloops, B.C.

best that money could buy and no pains have been spared to give the city of Kamloops a plant second to none in the country.

Auxiliary Pump House

The auxiliary pump house at the river is a reinforced concrete well or tank, with a motor room above. The motors are of the vertical type and are connected by long shafts to the pumps located near the bottom of the well, which is about three feet below the lowest water mark of the river. There is about 24 feet maximum variation of the river level, however, and this required careful design of the well to consider an upward pressure in the event of the intake gates being closed during high water flow of the river.

City Distribution System

Both water main and electric lines are brought from the power house underground through the concrete tunnel under the railway track, the electric lines being then carried up a tower in conduit and there distributed. The plant was placed in service on October 28th, and its operation for the requirements of the city service has been very satisfactory. The construction of the power plant and reservoir was carried through to completion with remarkable smoothness and efficiency, due, in a great measure, to the co-operation of all concerned toward making the work a complete success.

Halifax Installs Magnetites

During Christmas week the new luminous magnetite arc street lighting equipment was placed in commission in the city of Halifax, N.S. The old system of street lighting in Halifax consisted of the old style arc but a contract was recently entered into between the Halifax Electric Tramway Company and the merchants along the principal street under which the company agreed to install the new lamps, the extra

Fig. 1. Halifax main street, by night.

cost of maintainence being borne by the merchants. This contract is for five years. The cost of the old style of lamp was $62.50 per lamp per annum and the cost of the new lamp is $96 each per annum for an all night, every night, service.

The magnetite lamps are operated by a 50-light mercury rectifier, though at present only 28 lamps are installed. As may be seen from the accompanying illustration these lamps are mounted on ornamental brackets and attached to the

Fig. 2. Halifax by day, showing bracket design.

trolley poles. The lamps are spaced 110 feet apart on alternate sides of the street.

The inauguration of the system was made the occasion of a considerable demonstration on the part of the citizens. A procession was formed accompanied by the local bands, and paraded the area to be lighted until at a predetermined moment Mayor Bligh closed the switch which lighted the new system and at the same instant cut out the old type of lighting. The contrast was exceedingly gratifying, and the progressive merchants who undertook to bear the added expense of the new system are indeed to be congratulated on the success of their enterprise.

The equipment including lamps, brackets and rectifiers was all supplied by the C. G. E. Company.

Electric Luxury in Transatlantics

The varied application of electric drive and the refinements and luxury of electric control are nowhere better exemplified than in the magnificent new, twin, quadruple screw, passenger steamers, the Alsatian and Calgarian, of the Allan Line Steamship Company, on of which, the Alsatian, left Liverpool for Halifax on January 17 on her maiden voyage. These ships are now the largest in Canada's trade, being 600 feet in length, 72 feet wide, 28 ft. 6 in. draught, and 18,000 gross tonnage. There are eight decks, 11 watertight bulkheads and a passenger capacity, including officers and crew, of 2,350 persons. The power of the driving engines is 20,000 h.p. and the speed attained on trial, fully loaded, was 19 knots.

To supply the needs and comforts of this good sized isolated town, electrical equipment in all its modern phases of usefulness and refinement has been called into requisition. There are electric elevators, telephones, electric fire alarms, ample illumination, signal systems, ventilation and numerous machines for various purposes all operated by electricity, so that it will almost be possible for a passenger to forget that he is not spending a few days in one of the largest and most luxuriant hotels on the American continent. A brief description of the electric installation in one of these duplicate ships is given herewith.

The main electrical generating plant consists of three steam turbine driven sets constructed by the British Westinghouse Electrical Company each capable of giving a continuous output of 250 kilowatts at a pressure of 220 volts when running 3,000 revolutions per minute. The turbines of the main generating sets are of the Westinghouse impulse type, the normal stem pressure being 150 pounds per square inch, exhausting against a back pressure of twelve pounds gauge. A small emergency turbo-generator is also provided and placed in a separate compartment on lower promenade "C" deck well above the load water line of the vessel. This emergency set is also manufactured by the British Westinghouse Company and is of twenty kilowatt capacity at 110 volts.

The main generators are placed on an elevated platform on the port side of the engine room aft, and the main switchboard abaft of the machines on the bulkhead. The switchboard contains the three dynamo panels fitted with automatic circuits of massive design, voltmeters and ammeters of the moving coil type and shunt regulators for each dynamo, there being in all thirty circuit breakers and fourteen switches and fuses.

Three-wire Distribution

A special feature of the installation is the three-wire system which is now fitted for the first time on a large passenger ship. All heavy power circuits are fed direct from the main switchboard at 220 volts pressure, the lighter and smaller motors being supplied from either side of the three-wire supply at 110 volts. From the switchboard heavy lead covered cables are run on the port and starboard side to auxiliary switchboards placed in different compartments and interconnected by heavy cables through circuit breakers forming complete ring mains round the ship, these being so arranged that in the event of a failure on any cable a full supply is still obtained through the opposite feeders. Special precaution against heating has been made by carrying all feeders clear of the engine and boiler room on the deck above these compartments. The total number of lamps installed throughout the ship is about 3,000, all of these being metal filament type. Cables are also run from the main switchboard to the emergency dynamo room for supplying a separate emergency circuit, a change-over switch being provided so that in case of accident a sufficient number of lamps can be kept lighted in the engine room, boiler rooms and passenger accommodation; also on the boat deck should the main dynamos be shut down. Power is also available from this emergency dynamo for working the wireless installation and navigation lights.

Telephone instruments are fitted throughout the suite and special staterooms and connected through a central exchange situated on the main deck and in addition a system of inter-communication telephones between the officers' cabins and also a similar system in the stewards' department.

A complete installation of electric clocks of the magneto type is fitted in the public rooms, entrances and chart room controlled by a master clock.

Automatic fire alarms are fitted throughout the vessel with an indicator in the navigating room. Thermostats, or heat detectors are fixed in the different compartments. These can be set so as to give an alarm at a rise of 15 degrees Fahrenheit, and can be limited for compensation to any predetermined temperature; means are also provided to allow each circuit to be tested for continuity by pressing a button at the indicator.

In addition to the above a very complete system of fire alarm pushes and bells are fitted in corridors, etc., these being connected to indicators in the engine room and navigating bridge.

For the navigation of the ship Graham's loud speaking telephones are fitted on the navigation bridge, communicating between forecastle, crow's nest, docking bridge aft and chief engineer, Marconi room and bow.

Submarine Signals

A complete system of submarine signalling apparatus is fitted in the ship and also a semaphore with Morse flashing lamps and keys on a platform above the bridge.

Bell communication is fitted to every part of the ship with indicators in the different service rooms, buzzers being used in place of bells to guard against unnecessary noise in the vicinity of the cabins.

A navigation light indicator of McGeoch's new pattern is fitted for masthead lights, bow lights, anchor and stern lights.

A complete system of Stone-Lloyd watertight door signals has been fitted, each connected electrically to an indicator situated in the navigating cabin. This indicator consists of a watertight case containing an aluminium face with plan of the ship engraved thereon and having circular openings with ruby glass discs corresponding to the number and position of the doors and each illuminated by a separate lamp which indicates on the closing of the doors.

For the ventilation of the ship an elaborate system of hot and cold air apparatus is fitted, the whole of the fans for this installation being electrically driven. Forty-six motors are fitted which require over 150 horse-power.

Four large forced draught fans for boiler rooms, are provided and twelve ventilating fans for stokeholds and engine rooms, the total horse-power of these being 250.

Turbine lifting and turning motors, three in number, are provided of fifteen horse-power total capacity.

In galleys, electrical power is used for the bakery machine, cooking ovens, with motor driven spits, knife cleaners, dish washers, potato peelers and freezing machines, and a large number of electric hot plates are fitted throughout the dining saloons and bars for keeping food and liquids warm during service; this gear requires about sixty horse-power.

The gymnasium is equipped with motor driven appliances consisting of one frictional machine, one Seiste's machine and three horse exercise machines.

Curling tongs, heaters and fans are fitted in first class cabins, also wing fans in the public rooms.

A motor driven printing machine is also placed in the printing room.

The barbers' shops are provided with the latest type of electrically driven hair brushes, hair dryers and massage apparatus; each machine is fed from a socket placed in convenient position to the chair, no overhead shafting being required.

The steam whistle is worked by a small motor and solenoid enclosed in a watertight case placed in a convenient position near the whistle. Provision is made for blowing by hand cord in the ordinary way and the whistle can be operated by the three switches placed port, starboard and amidships on the Captain's bridge; these are so arranged that either "time control" or "signal control" can be made by turning to the right or left.

A Waygood Passenger Elevator is fitted in the centre of main stairway on first class accommodation, passing through five decks, two mail and baggage lifts and also two lifts for the provision chambers, the total power required for these lifts amounting to about ninety horse-power.

The Telephone Year in B.C.

One million dollars was the approximate cost of improvements made by the British Columbia Telephone Company during the year 1913. These improvements were not confined to any one district, but included work in the territory of practically every exchange the company operates, from the west coast of Vancouver Island to the eastern extremity of the Lower Mainland, at Kamloops in the middle interior, and in the Kootenay and Boundary districts. The principal piece of construction was the laying of the direct submarine cable to Vancouver Island from Point Grey on the mainland, details of which have already been given in these columns.

In its aim to establish a complete system the company laid out a general scheme of construction, and after several years of steady progress it has now the general lines of its plan filled out. While working with the object of meeting present demands, the company have also been obliged to provide for the future, and they are now so situated that additional service may be supplied at short notice.

Though a considerable amount of money has been spent during the past year, there was no single item, apart from the cable construction mentioned, that might be termed large. In Victoria, extensions to outside plants were comprehensive, these consisting of the erection of poles and stringing cable. A heavy amount of block work has also been under way there for some time past. In the district north of Victoria notable progress has been made in the re-routing of the longdistance line extending northwards. This line formerly ran over the Sooke mountains, and winter storms often interrupted service. Two new copper circuits have been constructed between Victoria and Nanaimo, with a short piece of submarine cable across Saanich Inlet. The toll lead now goes via this circuit, which should ensure continuous service. North of Nanaimo, a long distance lead was built to Parksville, and as the line from Cumberland and the Comox district runs via Parksville, an improvement was effected in the whole service on the eastern coast of the island. With the present facilities perfect telephonic communication has been established between any point on the lower mainland of British Columbia and any point on Vancouver Island. In and about Vancouver lines have been extended to suburban sections which were built up during 1911 and 1912. The largest estimate was in the Point Grey district, out of the Eburne exchange, where every applicant has been taken care of, several thousand feet of aerial cable being strung throughout the district.

A new long distance lead is now in course of construction between Vancouver and New Westminster, with better connection up and down the Fraser Valley. In New Westminster several large estimates were carried out. In Port Coquitlam a new exchange was cut over on January 13th, 1914, and in connection therewith considerable outside construction took place. At no point has progress been more noteworthy than at Kamloops. This town has experienced considerable expansion during the past year due to the large amount of railway construction which is under way in the district, and the telephone company has completed two large estimates there.

Improvements to pole lines provided the chief feature in the cities of the south-eastern part of the province, the principle work carried out recently being the changing of the system at New Denver, which included Silverton, from the old grounded system to the metallic system. In addition to this work the lead between New Denver and Silverton was shortened.

During the past few months the company's engineers have been engaged on the work of improving the transmission of the cable to Victoria via the Gulf Islands. This cable runs south from New Westminster to Bellingham thence by way of Lummi, Orcas and San Juan islands to Vancouver Island. Repeating coils have been installed with marked results, and further experiments are being made in the hope that even better transmission can be secured. This cable carries traffic from the lower Farser Valley to Victoria, and also from Washington state points, and forms an important connection.

It is to work of the nature stated above that the B. C. Telephone Company are giving the most attention now that its system, taken as a whole, is fairly complete. In persuance of their comprehensive scheme of construction the company have expended upwards of seven million dollars. The aim of this general constructional programme has been not only to keep thoroughly up-to-date in point of equipment, but also to have it sufficient to meet demands for a reasonable period in the future. That being the case, the company, while their system is not over-built, are well supplied with facilities and are in a position to take care of growth as it arises.

The past year also proved an active period as far as the erection of buildings was concerned. The company own their own building in nearly every district in which they operate. During 1913 new exchanges were erected at Fraser, a suburb of Vancouver, and at Port Coquitlam, and a suitable building was acquired at Greenwood. A six-storey plant headquarters was erected at Vancouver, and work inaugurated on the new eight-storey central office building on Seymour street, Vancouver, in which provision will be made for three exchanges. The steel frame work of this building is approaching completion, and the work of erecting the concrete basement was under way before the end of January.

Many New Companies

The following rural telephone companies have been incorporated:—Heron Rural Telephone Company, Limited, Heron, Sask.; Huron Rural Telephone Company, Limited, Tugaska, Sask.; Hanson Rural Telephone Company, Limited, Lajord, Sask.; Downing Rural Telephone Company, Limited, Lajord, Sask.; Hill Crest Rural Telephone Company, Limited, Bladworth, Sask.; Bonnie View Rural Telephone Company Limited, Loreburn, Sask.; Ellsworth Rural Telephone Company, Limited, Macoun, Sask.; Hildahl Rural Telephone Company, Limited, Estevan, Sask.; High Ridge Rural Telephone Company, Limited, Kennedy, Sask.; Pleasant Valley Rural Telephone Company, Limited, Bladworth, Sask.; Rugg Rural Telephone Company, Limited, Outram, Sask.; Star Rural Telephone Company, Limited, Antler Sask.

Electric Railways

New Cars for Montreal Tramways

In pursuance of their policy of providing additional facilities, the Montreal Tramways Company have placed a large number of new cars on the streets and also intend to operate many more, deliveries being made at the rate of from four to six per week. New routes will, however, be required to bring the entire rolling stock into use. The cars are of a new design, manufactured by the Canadian Car and Foundry Company at Turcot, just outside Montreal.

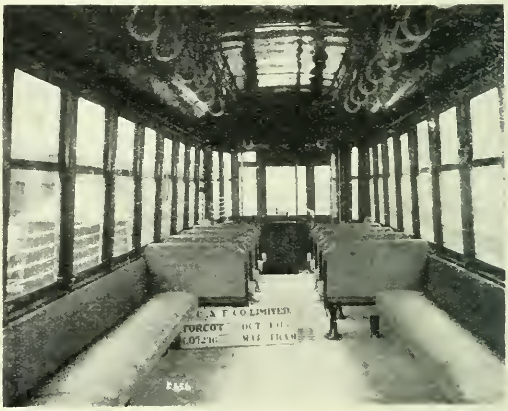
The underframe for the new design of car is composed of steel throughout, with 1-5 in. x 18 in. O. H. steel plate side girder running the full length of the car. Keystone corrugated galvanized steel plate, No. 22 gauge, is secured to the underframe which supports the composition flooring ⅝ in. thick at the thinnest point, which in turn is covered with 3-16 in. thick rubber tiling.

The platforms are supported by open truss knees, which are rivetted to side sills and suspended from the body and sill by bolts, making the platform detachable, facilitating repairs. The usual railings used on "pay-as-you-enter" platforms are provided, with the addition of one located on the rear step for dividing incoming and outgoing passengers. The front platform is separated from the body by two pipe stanchions, and exit is afforded through a folding door operated by the motorman.

New street cars for the Montreal Tramways Co.

The car is fitted with the plain arch roof, which has been adopted by the Tramways Company as their standard design in place of the monitor roof, its light weight, simple construction, strength and adaptability to exhaust ventilation being much more satisfactory.

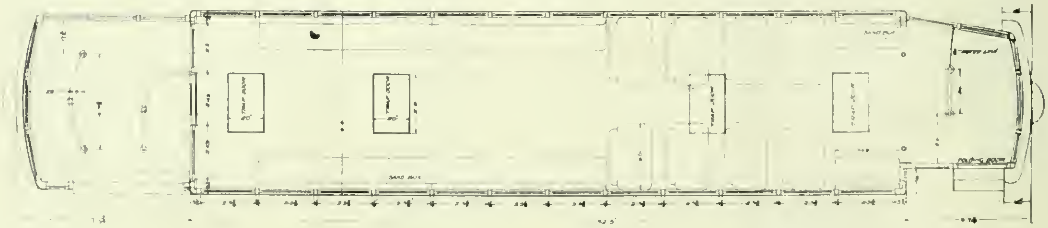
The seating accommodation, which provides for 44 passengers, consists of two longitudinal seats at the rear for 12 passengers each, and 10 Brill stationary back cross seats at the forward end seating 20 persons. All windows are arranged with double sash, top sash stationary and bottom to raise. The interior is finished in cherry, and sanitary hand straps are provided above the longitudinal seats.



Interior new standard Montreal car.

The general dimensions are: length over body 32 ft. 3 in.; length over platform, 45 ft. 8½in.; width over side sills, 8 ft. 2½ in.; height from rail to top of car, 11 ft. 4 in.; and height from floor to centre of headlining, 7 ft. 7 in. The weight of the body and truck, exclusive of electric equipment, air brakes, and heater is 33,000 pounds.

Owing to the type of roof, a new system of ventilation—the Garland exhaust—has been fitted. Electric heating is pro



Plan of car now being standardized by the Montreal Tramways Co.

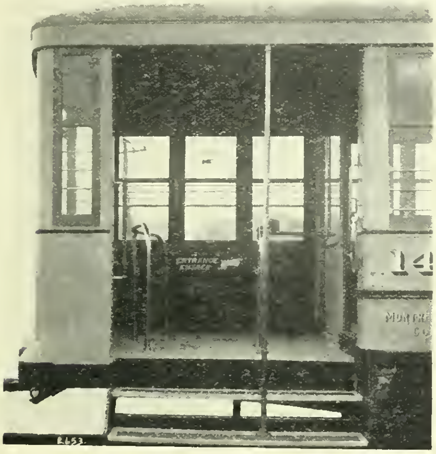
vided; the air is drawn through pipes under the seats, directly heated on entering the car and passes out through openings in the roof.

The motor equipment includes four motors of the 533 T 4 type, a K 35 G controller, rheostat, circuit breaker and lightning arrester, all supplied by the Canadian Westinghouse Company. The air brakes are Canadian Westinghouse D 1 E G straight air equipment and Canadian General Electric C P 27 straight air.

A new design in front signs is also fitted. These are lighted by two 62 volt, 40 watt tungsten lamps in series with four 110 volt, 16 c.p. carbon lamps. All wires run in conduits.

The truck scrapers are of a new type, designed by Mr. Blair, superintendent of rolling stock.

As explained in a previous issue of the Electrical News



Rear platform, p a.y.e. construction—Montreal.

this type of car will be operated in pairs, the trailer being almost identically the same as the motor car, only reversed, so that the two ends containing the horizontal seats are together. Twenty-five of these two-car trains are at present under construction.

Locomotive Operating Costs

The Galt, Preston & Hespeler Railway Company, Limited, placed a 40-ton Baldwin-Westinghouse locomotive in service on November 30th, 1910, which since that date has been in continuous operation, twenty-four hours every day except Sundays, averaging about 150 hours per week. This service includes hauling practically every kind of freight in standard steam railroad rolling stock, between the Canadian Pacific Railroad at Galt, Berlin and Waterloo, a distance of from 12 to 14 miles north.

Although the haul is not so very long there are a number of 2 to 2½ per cent. grades, from one to two miles long. The maximum number of cars hauled in one train is about 25, the average number being 15, and the tonnage per train is about 200 tons or on four trips of road service per day about 2,000 tons. It is hardly possible to estimate exactly the total mileage as the greater part of the time, 16 hours per day, the locomotive is in switching service. No record is kept of the tonnage and mileage, but the switching mileage would easily equal half, if not three-quarters, of the road service. This locomotive is equipped with four Westinghouse No. 308-B-2 commutating-pole, 600-volt, railway motors, rated at 120 h.p., and unit switch control.

The locomotive is given one-half hour inspection every twenty-four hours, and about five or six hours every Sunday, when making light repairs, such as applying brake shoes, changing wheels for tire running and inspection of motors, air-brakes, and control equipment. Tires have been turned twice since this locomotive went into service and the total repair amount to date is given below:

Air compressor (principally due to armature and field trouble due to low trolley voltage)	$170 00
Tire turning	15.00
Motor axle bearings	30.00
Unit switch control	50 00
Trolley parts, wheels, harps, poles and bases	110 00
Brake shoes	270 00
Miscellaneous	30.00
Total (from Nov. 30, 1910, to July 14, 1913)	$705 00

The total of $705.00 for repairs on this locomotive, covering a period of over two and a half years, is considered a very good record by the operating company in view of the large amount of service received.

The Effects of Rate of Fare on Riding Habit

By Mr. F. W. Hild, Gen. Mgr., Portland Railway, Light & Power Company.

In this paper, instead of placing rates first, Mr. Hild puts safety first, service second and rates last, as representing the logical order in which public service corporations should be approached. The author advances statistics shown diagrammatically in Fig. 1 as proof of his contention. Fig. 1 shows the riding habits of a number of American and British cities having populations greater than 150,000 about which the paper says:—

"It is quite clear from the chart that a low rate of fare is by no means the important determining factor in the creation of the riding habit. If it were, we should naturally expect to find the British cities with their smaller zone charges heading the list, while in the United States we would look for Cleveland, the champion low-fare city, at the top of the list, with Toledo next and Columbus, Toronto, Indianapolis, Milwaukee and other reduced-fare cities ranking close behind. As a matter of fact, the riding habit is seen to be greater in cities having straight 5-cent fare (Seattle's twenty five tickets for $1 do not carry transfer privilege). Cleveland is about midway and Toledo near the bottom of this list of American cities, where the British cities, despite the lower charges per ride, are far below American cities in the extent of street car patronage."

Factors Favoring the Riding Habit

In the judgment of the writer, the riding habit or the street car patronage by the people of a city depends upon:

"(1) Facilities.—Without facilities there can, of course, be no street car patronage. On the other hand, the more and better facilities, the greater the incentive to ride. The amount of trackage per capita and the number of cars operated per capita are probably the fairest measure of street car facilities in cities which have no rapid transit system like subways and elevated railways. In this respect the Pacific Coast cities lead the world, and this is reflected in the high degree of patronage they enjoy. In like manner, the rapid transit facilities of New York encourage the high riding habit of that city. This is strinkingly brought out in Fig. 2.

(2) Topographical Conditions.—People living in hilly cities will naturally ride more frequently than those in flat level cities. Thus we should expect to find cities like San

Francisco, Kansas City, Seattle and Pittsburgh show a high riding habit.

(3) Climatic Conditions.—Cities enjoying a great deal of sunshine and clear weather invariably show a higher street car patronage than cities where climatic and weather conditions are less favorable. During the bright, pleasant days people will come out for purposes of pleasure and convenience as well as business. In other weather they come out only of necessity. This is proved by the experience of each

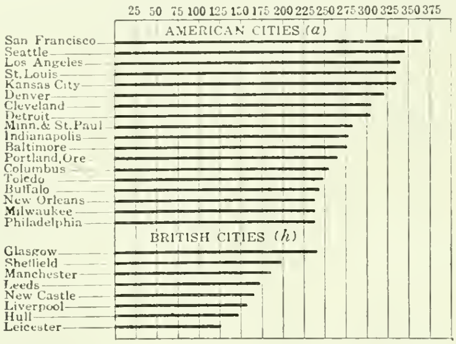


Fig. 1.—Riding habit—Annual revenue rides per capita.

city considered by itself in connection with the seasonal fluctuation of travel. Los Angeles, New York and tropical cities like Havana have favorable climatic conditions, and the effect is shown in the street car business. Such cities generally attract a relatively large floating population, which, of course, helps out in the street car patronage.

(4) Temperamental Characteristics.—A pleasure-loving people are usually liberal spenders, and they generally patronize the cars quite freely, as in Havana. People in mining communities are known everywhere to be more liberal spend-

age. If fares were abolished and transportation were free, the riding would, of course, vastly increase, while, on the other hand, if the present fares were doubled or otherwise very radically increased, the riding would naturally fall off. All this assumes that the facilities for urban transportation remain about the same. Increase of facilities, either in the form of greater comfort or in more widespread, quicker or added service, may stimulate enough travel from another group of patrons to counterbalance that lost by the higher charges. Thus, when the New York surface lines were separated under receivership proceedings, the transfer privileges were materially cut down, but the decrease in number of riders, if any, was more than made up by the patronage of the subways, for, as shown in Fig. 2, the points of the curve of riding for New York have constantly increased. A further demonstration of the principle is the liberal patronage created by the Pullman service of the railroads and the popularity of many extra-fare trains."

The author expresses his opinion that in the long run you get exactly what you pay for whether you buy street railway rides or any other commodity and on this point Mr. Hild expresses himself as follows:—

"Lower prices stimulate business" as a business maxim has an important corollary which is sometimes expressed: "In the long run you get exactly what you pay for, no more, no less." Thus good prices justify the expectation of fair goods and liberal service, while "cheap prices mean cheap goods." The latter maxim, indeed, but exemplifies an important phase of the natural struggle for self-preservation which is a law of business as well as of nature.

In the street railway field the operation of this corollary is significantly shown in the accompanying charts of trackage per capita Fig. 2 and of cars operated per capita Fig. 3, which combined are a fair measure of the investment per capita for street railway purposes. Thus the 5-cent fare cities lead the "reduced" far cities in street car facilities. Cleveland, famous as having the lowest fare in the United States, has since the beginning of the 3-cent car service in

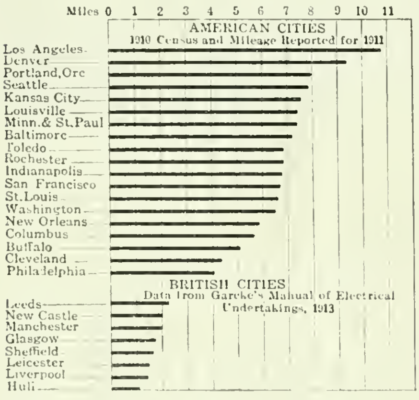


Fig. 2.—Miles single track for 10,000 inhabitants.

Fig. 3.—Cars operated during Evening rush hours.

ers than those in agricultural or mercantile communities. Cities which originated in the mining camps seem to have perpetuated these proclivities, and this characteristic is reflected in the riding habit. Thus one would expect San Francisco, Denver, Seattle and Pittsburgh to rank high in this respect.

(5) Rates of Fare.—At the rates of fare which now prevail, changes in rate, unless very radical, will have the least effect of all the factors which determine street car patron-

1910 added only 5 miles of track, despite the fact that its average increase of population has been and presumably continues at the rate of about 18,000 per year. Its total of trackage and cars operated per capita rank it below other cities which so far have escaped the fallacy of "reduced fares."

The absence of data as to "cars operated" in the British cities makes it necessary to consider the British "cars owned" in the cities compared. The charts of trackage and cars per capita strikingly bring out the superiority of American cities.

To just what extent low fares or the deadening inertia of municipal ownership is responsible for the marked inferiority of the British systems, in the extent of street car facilities, is difficult to state. But no doubt both contribute to the showing."

The figures herewith are taken from the Electric Railway Journal's presentation of the subject.

Single-Phase to 1200 d.c.

A current issue of the Electric Railway Journal describes a 1200 volt direct current installation which has recently been placed in commission on the Pittsburgh & Butler Street Railway to replace single-phase operation at 6600 volts. The article states that this equipment should be of interest as it is the fifth single-phase interurban road in the United States which has substituted 1200 volt d.c. for single-phase equipment.

Transmission is now by 3-phase, 22,000 volts, the original single-phase line being utilized by the addition of a third wire. Two sub-stations, respectively 10.12 and 26.44 miles from the generating station, each contain a 300 kva., 25-cycle, 1200 volt synchronous converter and a 300 kv.a., 3-phase, oil-cooled transformer, 22,000/740 volts, and the necessary switchboard with feeder and starting panels. The incoming 22,000 volt circuits are protected by aluminium lightning arresters. Choke coils, disconnecting switches, and oil switches are also installed.

The synchronous converters are rated at 300 kw. at 750 r.p.m. and are provided with the usual end-play, speed limit and brush raising devices. These machines are capable of handling 50 per cent. over-load for two hours, and three times normal load momentarily. A separate panel is used for starting from the a.c. side.

There are three grades on this road averaging from 7 per cent. to 9 per cent., but it is stated that the original schedule has been improved and speeds as high as 48 miles per hour are common with a maximum of 60 miles on favorable grades.

Figures given show that a reduction in power consumption per car mile of not less than 15 per cent. has been shown for corresponding periods and in addition the mechanical and electrical force at the car house has been reduced 54 per cent. compared with that employed a year ago. The total length of road operated at 1200 volts is about 28 miles.

Anxious for Radials

Some 150 representatives from Berlin, Waterloo and the counties of Waterloo and Oxford recently assembled in Berlin and discussed the hydro-radial question. The following resolution was unanimously passed.

"Moved by Mayor W. S. Hobson, seconded by J. G. Reiner, That the municipal councils of Woodstock, Berlin, Waterloo and Wilmot. Bleinheim, Blandford, East Zorra, Wellesly and Woolwich townships be requested to make an immediate application to the Lieutenant-Governor-in-Council to investigate as to the advisability of constructing electric railway lines under the auspices of the Hydro-electric Power Commission of Ontario, as follows:

Berlin to Woodstock, serving the following points—Mannheim, New Dundee, Washington, Plattsville, Bright and Innerskip.

Berlin-Wellesly, serving Waterloo, Heidelberg, St. Clements, Hawkesville, Linwood, Cross Hill, Wellesly, Barberg and St. Agatha.

Berlin to points in Woodwich Township, serving Bloomingdale, Connestogo, Winterbourne, West Montrose, New Germany, Elmira and Floradale, and that the immediate committee be appointed to urge upon their respective councils the immediate passing and forwarding of such resolutions."

16,000 Volt, Single-Phase Line

A single-phase railway line has recently been placed in commission between Vienna and Pressburg, Hungary, which operates at 16,000 volts single-phase. On the locomotives the voltage is stepped down from 16,000 volts to 600 volts a.c. for use by single-phase commutator motors. Both passenger and freight locomotives are rated at 750 h.p., the former travelling at a little less than 50 miles and the freight at 25 miles per hour. Pantagraph collectors are used in each case.

Personal

Mr. W. K. Stalford has been appointed electrical inspector for the city of Hamilton.

Mr. H. D. Bayne has severed his connection with the Canadian General Electric Company. Mr. Bayne has held a prominent position with this company for a number of years as special agent.

Mr. Hugh L. Cooper, chief engineer of the Mississippi River Power Company during construction work, has opened an office at 101 Park Ave., New York City, to engage in the practice of general hydraulic engineering.

Mr. H. Doughty, superintendent of the Regina municipal railway system was recently presented with a handsome loving cup by the members of the Street Railway Mens' Union of Regina. This may be taken as indicating the spirit of co-operation and good feeling that exists between the officials and the men of that system.

Mr. Julian C. Smith, manager and chief engineer of the Shawinigan Water and Power Company, Montreal, has been awarded the Gzowski medal by the Canadian Society of Civil Engineers for his paper on "High Voltage Transmission Lines." This paper was reproduced, at the time of its presentation, in the Electrical News

Mr. Goodwin Shenton.

Mr. Goodwin Shenton has been appointed manager of the Winnipeg, Vancouver and Victoria branches of John Millen & Son, Montreal. Mr. Shenton is a native of Winchester, England, and was educated at the Peter Symonds School, Winchester, and at Hartley University. He was articled to the late Dougal Drummond, of the London & South Western Railway, and spent six years in the works and designing offices of that company. Coming to Canada in 1911 he joined the railway supply department of John Millen & Son, latterly acting as assistant to Mr. F. D. Lyman, the manager of the department. He has now been appointed to their Western branches and has taken up his duties there.

The Development of Wireless

A paper on the history and development of wireless telegraphy was read by Mr. A. E. Reoch, secretary-treasurer of the Marconi Telegraph Company of Canada, Limited, at the meeting of the Montreal Electrical Society on February 2. Mr. Reoch, who is an authority on the technical side of wireless, described the experiments which resulted in the present apparatus, and the methods of transmission and receiving. He also described the system of duplex wireless telegraphy, and how various difficulties had been successfully overcome by Mr. Marconi.

Illumination

Ornamental Street Lighting, Peterboro, Ont.

By Mr. L. Burpee

The tendency which has been so widespread during the last two years towards the use in street lighting of Canadian General Electric ornamental luminous arc lamps, placed at frequent intervals has been inspired primarily by an ever increasing appreciation of the value, when viewed from every angle, of intensive or ornamental lighting for business and principal residential sections. A survey of the movement indicates that credit must be given first to those merchants who showed their faith in the new lamp by making arrangements for its installation, that is, by agreeing to pay installation and operating charges on a foot frontage basis. So eminently satisfactory did the new lamp prove that in the last two years over 10,000 have been installed in the different cities of Canada and the United States. In Canada during the last year installations were completed at Calgary, Edmonton, Winnipeg, Westmount, Halifax, Lindsay and Peterboro, though at none of these places, perhaps, was more jubilation indulged in, when the new system was put into commission, than at the last named place. Here the old well-known open arc lamps, installed at about 25 feet above the roadway on mast arms secured to wood poles at street intersections, had held the field alone for many years.

The work of installing the new equipments had been pushed forward to completion and the system put into working condition and inspected in every detail before it was finally announced that it would be inaugurated by Mayor Bradburn at 8 o'clock Wednesday evening, December 17th. The mayor and the city council, shortly before the hour appointed, drove to the city hall, where they were met by crowds of interested citizens. Two brass bands, to show their appreciation of the city's undertaking, offered their services and furnished appropriate music. His Worship began to address the multitude by the dim light of the old system shown in photograph, Fig. 1, but in the midst of his remarks

Fig. 1—George St., Peterboro, midnight. Taken from same point as Fig. 2, same exposure, 5 min. Old open arc lamp system. Night dark and rainy.

Fig. 2—George St., Peterboro, midnight. Taken from same point as Fig. 1, same exposure, 5 min. New magnetite arc lamps. Night dark and rainy.

and just as the great clock overhead sounded the last stroke of eight, the one hundred ornamental luminous arc lamps burst forth in magnificent brilliancy, changing the streets from darkness to comparative daylight, amid cheers and expressions of surprise and approval. Mayor Bradburn concluded his remarks with, "Ladies and gentlemen, there is the best lighted street in the Dominion of Canada, and that is saying a good deal" (see photograph, Fig. 2), and called upon alderman Johnston, who was chairman of the lighting committee, to address the citizens. At the conclusion of alderman Johnston's remarks, a procession, headed by the bands, formed and proceeded along George street, the principal thoroughfare of Peterboro, and ended with a second round of cheering at the sub-station, where the council made an inspection of the station equipment. Details of the installation are as follows:

Cable

The installation consists of 19,500 feet of No. 6 B & S. solid, tinned copper conductor with 6/32-in. N. E. C. rubber and tape insulation, and with 7/64-in. lead sheath and double steel tape armor. There is a jute bedding between lead and sheath and also a jute winding over the armor. Net weight of cable was 43,500 lbs. It was tested at 10,000 volts a.c. for ten minutes. The cable is buried in the ground 24 inches below the surface of the sidewalk. The trench dug in laying it was 14 in. wide and 18 in. deep. The cable enters the iron poles through 2-in. wrought iron bends laid in concrete. The lead sheathing is bonded at each lamp insertion.

The armor at each insertion is soldered to the lead sheath and is also grounded at every third lamp.

Poles

There are eighty-six combination trolley and light poles placed opposite on both sides of the street on 115 ft. centers. They are set with a 6-in. rake and are placed 5 ft. 3 in. in the ground on a 3-in. cement bottom to prevent sinking. Holes 18 inches in diameter were filled with concrete, using one and one-half bags of cement per pole. The total length of pole is 28 ft., made up of three sections of wrought iron pipe. The streets are 42 ft. wide between curbs. The centers of the poles are 10 inches from the curb so that the distance between arcs of opposite lamps, when mounted on the ornamental brackets, is about 40 feet. Each post has an ornamental base 16 inches square at the bottom, 8 inches square at the top and 41 inches high. The lamps are placed so that the arcs are 16 feet above the sidewalk. At the railway crossings the poles increase in length, stepping from 28 ft. up to 32 ft. and then up to 35 ft. over all, the latter being 7 inches in diameter at the bottom section.

There are fourteen ornamental standards on cross streets having no street railway, spaced 120 ft. apart and placed on both sides. Arcs on these are 14 ft. 6 in. above sidewalk. Lundin cutouts are used throughout, being placed in the brackets on the combination poles and in the bases of the ornamental standards.

Station equipment

The station equipment consists of two Canadian General Electric 50-light, 60-cycle, combined unit series mercury arc rectifiers. These receive energy at 2200 volts and first step it up to 14200 volts at the terminals of the constant current transformer secondaries and then rectify it to 6.6 amperes d.c. at 4500 volts. Current is supplied to the load circuit at a constant value of 6.6 amperes, the voltage varying with the number of lamps in series. The current will not vary more than two-tenths of an ampere from normal between full load to one-third load with full load adjustment. An 80 per cent. load tap is provided for use on low loads. The accompanying photographs were taken at the same point at 12 o'clock midnight December 23rd and were given equal exposure. The night was dark and rainy. The old open arc lamps are shown in Fig. 2 hanging much above the ornamental lamps.

Two Circuits

There are two independent circuits, one from either rectifier equipment, with lamps so connected that all the lamps on the west side of George street and those on the north side of cross streets are in one circuit while those on the east side of the former and on the south of the latter, are in the other. By this arrangement, one circuit can be cut out at midnight and yet leave the streets well lighted. To obtain even burning of electrodes, the circuits are cut out alternately.

Installation of the Peterboro system was made by Mr. J. H. Greer under the direction of Mr. R. J. Jeffrey of the Hydro-electric Power Commission of Ontario.

Factory Lighting

By G. H. Stickney

The economic value of good illumination, aside from accident prevention, is evident in the greater facility with which an employee can work under good illumination and the greater accuracy with which gauges can be read and tools can be set. One large manufacturer, on investigating his lighting conditions, found certain departments in which the operatives were practically idle for about an hour a day during the winter months, solely on account of darkness. Good artificial illumination can be furnished in such a factory for eight hours a day at a cost equivalent to about five minutes of the time of the workmen benefited. This illustrates the extravagance of poor lighting. For a great variety of conditions good illumination reduces the manufacturing cost by increasing production, raising the quality of workmanship and reducing the number of defective parts and "seconds."

Accident Prevention

The phase of accident prevention is illustrated in the case of the foundry or other shop where cranes or other powerful machinery are in operation. The likelihood of crane and elevator accidents is greatly reduced with proper lighting. In the foundries and yards of a plant it is practically impossible to eliminate irregularities under foot. If not illuminated, these may readily cause falls, with resulting injuries; and in foundries where molten metal is carried and hot metal abounds they may often cause serious burns. Even though guarded to the fullest extent, powerful machinery presents a menace unless the operatives are given an opportunity to see and thus avoid the danger points.

As to the preservation of the eyesight, there are many manufacturing operations which cannot be carried on without accurate visual inspection. Some of these produce considerable strain even under good illumination, and to require their performance under poor illumination is certain to result in more or less rapid impairment of vision.

Undoubtedly a higher intensity of illumination is needed in most workrooms, but there are other features of equal and sometimes greater importance. The minimum intensity acceptable generally depends upon the reflecting power of the surfaces to be seen, the fineness of the detail to be observed, the time of observation and the closeness of application. Unless glare be introduced, a higher intensity of light is rarely objectionable, except from the standpoint of cost. The gain secured by the increase of intensity is not proportional to the intensity, and there is a point beyond which the gain would not warrant the additional cost.

The most common defect in lighting is excessive glare and absence of diffusion. Glare may emanate directly from the light source or be reflected to the eye by a glossy surface; it can also be caused wherever excessive contract of intensity appears in adjacent fields of vision. The dazzling effect is unpleasant and interferes with seeing. Under continued exposure eyestrain and even permanent injury to the eye may result.

Use of Reflectors

The workman frequently complains of insufficient light when in reality the intensity may be higher than is required for the work. In case an attempt is made to correct this by installing a larger light, the workman's eyes are subjected to a still more severe strain. The proper correction should be to shield the light by means of a proper reflector. As such a reflector would tend to direct more of the light upon the work, the working intensity would be increased; hence in many cases it may be possible to reduce the size of the lamp, or relocate it so as to enlarge the area illuminated.

When a light cannot be removed entirely from the field of vision its brilliancy should be reduced by means of a diffusing globe or reflector so as to increase the apparent size of the light source and reduce the contract between it and the background and the sharpness of shadows in the illumination.

Glare received from specular reflection of glazed paper, desk tops or polished metal often induces eye trouble, headache, and other indispositions, though the sufferers may not be aware of the cause. The remedy is to change the relative positions so that the reflected light is kept out of the eyes as much as possible and to enlarge the dimensions of the light source.

The Dealer and Contractor

The Status of the Electrical Contractor

Did it ever strike you that the most difficult man to locate on a piece of construction work is the electrical contractor? Nobody seems to have heard that name. They will tell you who the architect is, or the general contractor, or the painter, or the brick layer, but the electrical contractor—that is a new one.

Yet it may be safely taken for granted to-day that the installation of electrical equipment in the majority of our buildings is one of the most important features in the appearance, comfort, economy and utility of that building. Why then the difficulty in locating the electrical contractor? The answer seems to lie in two directions. First, the electrical contractor of the past has been a man of no particular standing with no particular knowledge, but has been a graduated wireman at the best. Second, the architect, or possibly the general contractor, has taken it on himself to advise in these matters, a function clearly outside and beyond his territory, both because he has not the necessary knowledge and because the electrical installation does not play any particular part in the general scheme of architecture, artistic or otherwise. We are inclined to think the architect has been much at fault in this respect. In dealing with the owners of buildings he has been dealing with people who know nothing of electrical matters, and who were easily mislead. In the vast majority of cases the architect had no intention of misleading, probably, but his error resulted from the fact that he did not know the scientific possibilities of electrical contracting, and he did not know that he did not know.

With advance in electrical contracting and the appearance in the field of better trained, even scientifically trained, men the status of the electrical contractor has been wonderfully improved and there is now neither reason nor excuse why this work should be handled by anyone else. There are yet however a great many architects who fail to confer with the electrical contractor, regarding the installation of his material, until it is too late. For example, the case of a factory lighting installation was brought to our notice a few days ago where a room 100 ft. square and 12 feet high was being allowed only 9 ceiling outlets. It is greatly to be feared the electrical contractor will be blamed for the poor illumination while the architect will be commended for the handsome appearance of the exterior of the building. Regarding the relation between architects and electrical contractors an interesting paper appears in the current issue of the National Electrical Contractor, by Mr. J. C. Austin, which we reproduce in part:—

"The relations that existed between an architect and an electrical contractor a few years back were very unsatisfactory for several reasons—the first being that most architects did not know the rudiments of electricity, and as a consequence had to rely on the knowledge of the electrical contractor, and generally the one who submitted the lowest bid (owners seldom accept any other). The man submitting the lowest bid is not always an embryonic Edison: very often he is a financial fool who has simply counted up the number of outlets and guessed what it would cost to give a result that would pass the inspection of the architect (who was, as I said before, densely ignorant of the subject) for the smallest amount possible.

After the contract was awarded and the work was started, the contractor's assumed profits began to look microscopically small, so he would then invade some kindergarten and employ labor from that source. He would watch these students work (somewhat as Tom Sawyer watched his playmates paint the fence), and then when it was done, he would apply his certificate. The architect would then inspect the work, make a few kicks for form's sake, and then issue the certificate; saying that the work was all right, but not saying anything about the beneficent Providence, which, in most cases, looked over it all and gave both architect and contractor the benefit of the doubt.

Another case of trouble was the practice pursued by some architects of letting the contract for electric wiring to a general contractor, who would then have to sub-let the wiring and other electrical work to an electrical contractor. The general contractor would always feel bound to let the electrical work to the man who could string the most wire for the least money; this, on the face of it, was a poor method, as money was the one gauge by which everything else was measured.

It is obvious that an architect cannot master every branch of electricity any more than he can master all of the technical details of plumbing, painting, stone-masonry, and the numerous other items which are necessary to complete the modern building. The wise architect (and he is generally over thirty) when he has an important building to undertake, will consult with experts in every important branch, and in so doing he will get in touch with the latest appliances and will have a specification that, when it is read, will not bring a smile to the face of the one who knows.

The demands for electrical apparatus are so numerous and important that the work of an electrical contractor should be independent of that of the general contractor, and he should be treated as an original contractor instead of as a sub-contractor. When an architect lets all of his so-called sub-contracts to what is known as a general contractor, he is simply trying to save trouble to himself; and in saving himself the immediate trouble, he is not conserving the interests of his employer (the owner), but is breeding trouble and consequent dissatisfaction for every one concerned.

The general contractor knows nothing about electricity; then why should he be employed, and why should the owner pay a double profit? By a double profit, I mean profit for an electrical sub-contractor and the other profit being for the general contractor who is supposed to shoulder all responsibility, which responsibility generally consists in figuring a large amount for the wiring and sub-letting it for the smallest amount possible without reference to quality.

The time of the specialist has come in every walk of life, and the expert electrical contractor will have to be recognized as a specialist and as an independent contractor by every architect and owner."

From Torch to Tungsten

The Canadian Sunbeam Lamp Company have recently completed a very telling demonstrating machine which is known by the title "From Torch to Tungsten." This machine was conceived with the intention of pointing out the gradual development that has taken place in illumination and to emphasize the efficiency of the "Sunbeam Mazda" lamp. This company is getting out, for the use of their dealers, some 25 other small demonstrating machines, which they will furnish on request. None of them are quite so elaborate, however, as the Torch to Tungsten demonstrator, four views of which are shown herewith. Fig. No. 1 begins with Rome, the period of Flares; Fig. No. 2 represents the Candle and Lamp period; Fig. 3 the Gas period; and Fig. 4 the incandescent electric light period. In the upper portion of each figure a house is shown illuminated with Sunbeam mazdas. The following brief description accompanies this demonstrating machine.

The different periods in which man has been able to increase the quantity and quality of artificial light in the world is the interesting story told by the Mazda Window Exhibit. From the smoking torch of primitive man, down the ages to the marvellous mazda electric lamp of to-day; from the eerie shadows of the dimly lit cave of the cave man to the brilliantly illuminated home of this year of grace 1914, is a long cry. The six epochs in the story of Light are set forth in ingenious detail in the six miniature homes that make up the Mazda Window Display. Lighting system and furniture are shown true to period.

Roman flares, 396 B. C.—The crude torch of primitive man gained ornament and usefulness at the hands of the Roman. In Rome, about 396 B. C., flares provided artificial light. The flares were long vase-like vessels of brass, capped with a bowl into which was placed resinous wood that burned like a brazier. Next came the Roman Candle—a string dipped in tallow and pitch. Another stage of the candle appeared in England in the form of a chip dipped in tallow.

Candles in England, 1483.—The second model in the exhibit shows the candelabra of England in 1483. The candles were of wax and grouped to give the required complement of light. For two hundred years after the perfection of the wax candle, illumination had not experienced any great improvement until the invention of the paraffin lamp.

Paraffin Lamp, 1842.—In 1842 the world welcomed the paraffin lamp. This lamp burned oil and was then thought to be the final word in the world of artificial light. This invention of a native of Alfreston in Derby, England, ruled supreme until the introduction of gas as an illuminant.

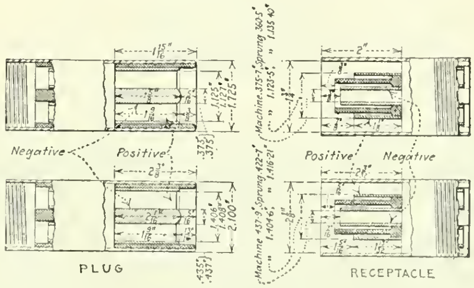
Gas, 1860.—The first recorded use of gas was about 1600, when a Scotchman with an inquiring mind, induced a gas flame by igniting the protruding end of a pipe inserted into a bladder filled with gas. His discovery was gradually improved and commercialized until in 1860 gas was used generally for illumination. Gas illumination received a great impetus when Humphrey Davy invented the arc light.

Electric Light, 1881.—The world of light was stirred by the advent of the first incandescent electric light, invented by Swan in 1881. Electric light has been gaining in service and use ever since that date. Electric illumination for home and office has reached its highest efficiency in the tungsten lamp, sold and used wherever there is darkness to dispel.

The period of the tungsten lamp.—The discovery and scientific application of tungsten—a ductile metal capable of being drawn out into cob-web like threads—has been the means of increasing by over 100 per cent. the efficiency of electric illumination as we have it to-day in the modern incandescent electric service. Delicate wires of tungsten inside the electric lamp form the core of a great white glow—greatest in intensity and least in cost. In the very latest types the vacuum, so long considered an essential of the incandescent, has been replaced by an inert gas, generally nitrogen. But this is only a refinement of the tungsten lamp.

Standard Charging Plug

The Electric Vehicle Association of America recently standardized a charging plug in both the 50 ampere and 150 ampere sizes. The details and dimensions of these plugs are shown in the accompanying cuts. The most noticeable feature is in connection with the polarity in connection with which it will be noted that the outside contact is positive and the inside contact is negative. The Association hope that every effort will be made by manufacturers and users to adopt this standardized plug as this would result in added satisfaction to the customer at reduced cost.



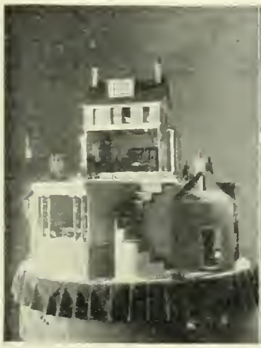


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Single Phase House Meter

The Siemens Company of Canada are placing on the Canadian market a single-phase house service meter possessing several original and interesting features that will no doubt appeal to power engineers interested in the sale of energy. The aim in designing this meter has been to so construct it that all the parts liable to deterioration through wear and tear can be very easily replaced without requiring the meter to be dismantled. Further, there is a total absence of soldered joints, all the internal connections in the meter being made by means of proper connectors. Where a number of small wires come together, which in the usual construction are soldered, in the Siemens meter they are brought down to a small terminal board and mechanically connected. The adjustments for the various loads are of a simple nature and accessible from the front. All these features, combined with good mechanical construction and simplicity in the arrangement of the parts make for permanence in the calibration.

The drawings in Figs. 1 and 2 give the front and side

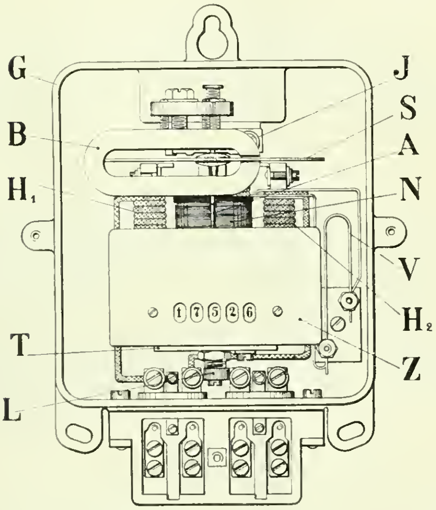


Fig. 1

elevations of the W3 meter, and Figs. 3 and 4 are views of the renewable top and bottom bearings in detail. The motor part of the meter is built upon a cast iron base G. Part of the iron case forms part of the magnetic circuit of the meter. The laminated iron yoke E consists of three limbs, as shown in Fig. 5, the middle limb being somewhat broader than the two outer limbs. The magnetic circuit is closed through a projection in the casting of the iron case G, as shown in side elevation Fig. 2.

In the slot or air space between the pole faces and the above mentioned cast iron projection, room is provided for an aluminium armature disc to rotate on this spindle A. On the middle limb of the yoke E is wound a shunt or pressure coil N and on the two outer limbs are wound the two outer current coils H_1 and H_2. The shunt winding consists of two parts, the main shunt winding and the auxiliary winding K, giving the necessary phase adjustment for inductive loads. The auxiliary winding K is adjustable by means of the resistance wire V. The meter armature is braked by a permanent magnet B; on the armature spindle A is the worm O, which gears into the first wheel of the counting train Z, the counting train being of the same pattern as in the W_{10} and W_2 types.

Special attention has been directed to both the top and the bottom bearings, which are described in detail accordingly:—

Top Bearing.—Referring to the drawing in Fig. 3, N is

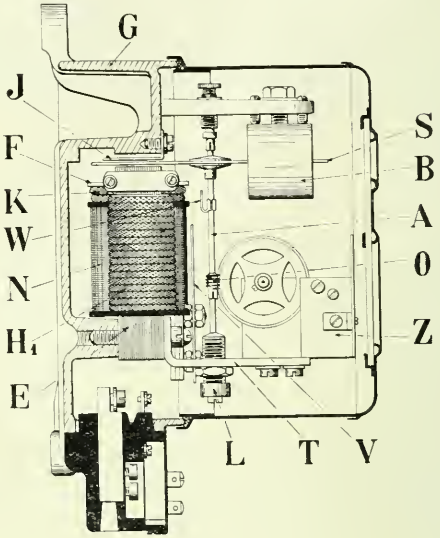


Fig. 2

the spindle of the meter armature, P an oil well in which the top pivot L works and supports the armature spindle N. The oil well is contained in a sleeve O, which can be withdrawn by means of a tool which screws on to an outside thread of the sleeve O provided for this purpose. To examine or renew the top bearing and its oil well the nut M is first loosened and the screw K which contains the pivot L can be withdrawn. A special tool provided with an in-

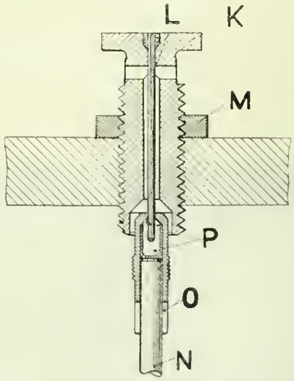


Fig. 3

side thread is then inserted and screwed on to the sleeve O which can then be removed from the spindle N by a gentle pull. Only the finest clock oil is used.

In putting the parts back again, similar operations are performed, but in the reverse direction, i.e., the sleeve O is screwed into the special tool provided, and it can then be

pushed onto the spindle N as far as the bottom of the oil cup P against which the top of the spindle N sits. The tool can then be withdrawn by unscrewing it off the sleeve O and pivot screw K can be screwed home, care being taken to see that the pivot point L is not damaged in inserting it

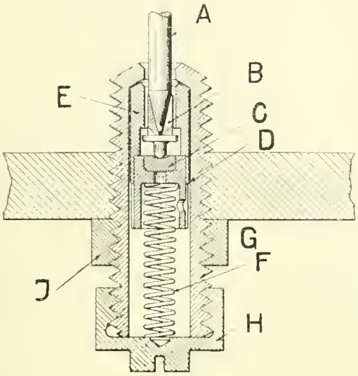


Fig. 4

into the oil well P. The distance of "Shake" having been adjusted, K should be secured by the lock nut M.

Bottom Bearing.—Referring to drawing in Fig. 4, B is the detachable pivot of the meter armature spindle A resting on the jewel stone C. To renew the bottom jewel, the nut H should be unscrewed, this will expose a spring F, a gentle pull on which will bring away the bottom jewel C and also the bottom pivot B which is held by oil cap E fitting over the jewel holder D. The various parts all come away as one piece, and are intended to be renewed as such, but the cap E can be removed so that the pivot point B and the jewel stone C can be examined or renewed. The spindle A is shaped to a cone at its bottom end, so that the pivot point B is held friction tight when the nut H is screwed home.

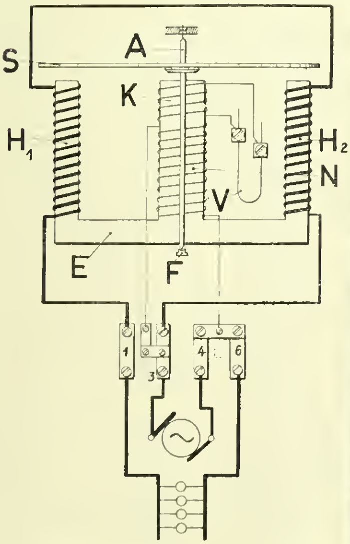


Fig. 5

The meter will start on a load of between 0.5 and 1 per cent. of full load. The starting current adjustment consists of a copper shoe J screwed to that projected part of the cast iron base which completes the magnetic circuit. The shoe J is slotted for adjustment purposes.

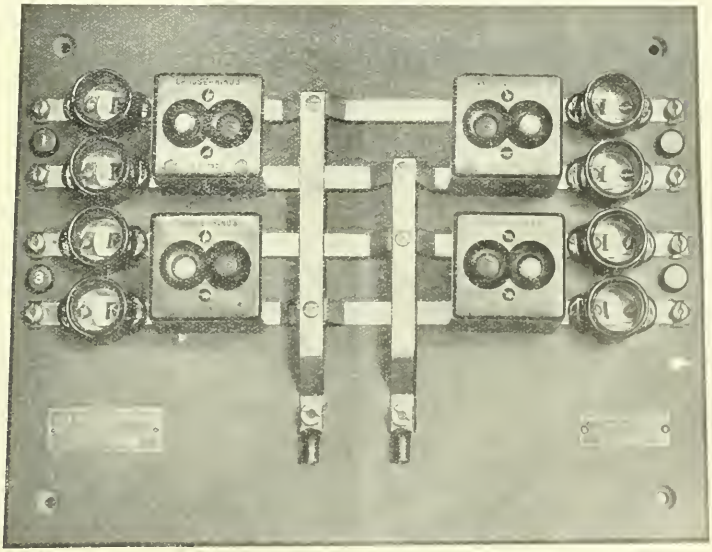
In order to prevent the meter from the risk of running on the shunt alone, a small piece of bent iron ribbon W is fixed to the spindle A, so as to be attracted by the magnetic leakage of the shunt or pressure coil N.

As before mentioned the whole of the meter is built and secured to the cast iron base G, which is closed completely by a sheet metal dust-tight cover, and a separate cover is provided for the terminal box. The terminal box can be separately sealed, and both ends of the pressure circuit are available for testing purposes without breaking the seal of the meter cover proper.

An arrangement which is typical of the ingenuity employed in the construction of the meter is the way in which the holding down screws of the cover are made. The screws just under the head are necked down in such a way that the cover may be loosened and taken off without having to remove the screws from the cover. It thus becomes practically impossible to lose these screws. This is only a little point but one which will be no doubt appreciated by meter testers and others who have to handle the meters, as the screws cannot be mislaid or dropped.

New Panel Board

A new type of panel board has just been placed on the market by the Crouse-Hinds Company of Canada an example of which is illustrated herewith. This board is of the push button switch type which this company in future will standardize and in which line they will carry a very large and complete stock from two to thirty circuits inclusive. If specially ordered new panel boards will be furnished with the fixtures of any particular manufacturer required. The simplicity and neatness of the board are very apparent from the illustration.



High Pressure Pumping Equipment

The Westinghouse Electric & Manufacturing Company have entered into a contract with the city of Boston, Mass., for all machinery and equipment for a central high pressure fire pumping station. This contract includes six 3000 gallons per minute 6-stage centrifugal pumps; six 700 h.p., 6000-volt, 60-cycle motors; six 13200-volt, 25-cycle, 800 h.p. motors, complete with switchboard and controlling apparatus; also necessary travelling cranes, and all heavy piping and large valves for the complete equipment of the station.

Each pump will be connected by a magnetic coupling on one end to a 700 h.p., 60-cycle motor and the other end to an 800 h.p. 25-cycle motor. Under normal operation each pump is driven, its 60-cycle motor furnished with current from the lines of the Edison Electric Illuminating Company of Boston. Should any mishap, however, occur to the 60-cycle supply, the pump can be instantly operated by its 25-cycle motor fed from the lines of the Boston Elevated Railroad Company. The increased size of the 25-cycle motor is due to its speed being 732 revolutions per minute, while that of the 60-cycle motor is 702 revolutions, these speeds, of course, being determined by the respective frequencies of the circuits. The motors have wound secondaries, and they do not start until the first point of the automatic controller has been passed. At this point the circuit of the magnetic clutch between the motor and the pump is completed.

The 800 h.p. motor will be the highest voltage wound secondary motor ever built—13,200 volts being the potential for which it is designed.

The business district is to be underlaid with special high pressure water mains to be used for fire service only, and in case of fire within this district, the alarm is sounded in the pumping station and in the fire houses simultaneously. This permits the electrically operated pumps being started at once, and the pressure raised in not more than 45 seconds to 300 lbs. per square inch all over the system of high pressure mains. Upon arrival of the fire hose at the point of the fire, the hose can be connected directly to the special high pressure hydrants, and water taken directly from the mains at sufficient pressure to render the use of steam fire engines unnecessary and useless. This is a system which is coming into favor in congested business districts, as it gives increased protection and makes it unnecessary to rush through the dense traffic of such districts with heavy steam fire engines.

The contract has been awarded for the wiring and lighting of Toronto's Civic Abattoir to the Toronto Electric Company. The work will be under the personal charge of Mr. J. W. Helps.

Mr. E. W. Sayer, of the Sayer Electric Company, has been elected second vice-president of the Montreal Builders' Exchange.

New Companies

The Canadian Halley's Motors, Limited, has been incorporated with capital $10,000 and head office Montreal.

The Keystone Electric Company, Limited, has been incorporated with capital stock $75,000 and head office Hamilton.

La Compagnie Electrique de Saint Polycarpe has been incorporated to exploit some water powers in the county of Soulanges. The head office of the company is at Couteau Landing.

The Canadian Callophone Company, Limited, has been incorporated with head office Victoria. This company has acquired Canadian rights for certain existing inventions in relation to a loud sound producer and sensative sound receiver known as the callophone.

The Central Garage & Electric Company, Limited, has been incorporated with capital $7,000 and head office Moncton, N.B.

Trade Publications

Memoir No. 3.—Issued by the Department of Mining of Canada describing, with illustrations, the basins of the Nelson and Churchill rivers; compiled by Mr. Wm. McInnes.

Catenary Line Material.—Catalogue DS843 issued by the Westinghouse Electric & Manufacturing Company illustrating and explaining the details of their catenary line material.

Small Motors.—No. 18 of the monthly issue of small motors by the Westinghouse Electric and Manufacturing Company treating the subject of small electric motors and their application.

Induction Motors.—Bulletin No. A-4185 issued by the power and mining department of the Canadian General Electric Company describing and illustrating type KS. single-phase induction motors.

Motor Starters.—A folder issued by the Allen-Bradley Company, of Milwaukee, describing their type H alternating motor starters. The company lay particular stress on the protective features of this rheostat.

Simplex Manual.—Booklet issued by the Simplex Wire & Cable Company of Boston, containing, in addition to information regarding simplex brackets, tables and data for the ready reference of electrical engineers, contractors, wiremen, etc.

Your Silent Salesman.—A very interesting booklet issued by the Canadian Sunbeam Lamp Company, Limited, Toronto, describing a number of very interesting window displays that have been devised by this company to demonstrate the efficiency and stability of their lamp products.

Safety First.—A booklet issued by the Accident Prevention Committee of the National Electric Light Association explaining how to organize and carry out a campaign for the prevention of accident. The booklet is divided into five sections:—Introduction, Organization, Method of Procedure, Educational Methods, Conclusion.

Canadian Westinghouse—have issued the following publications—a folder describing ventilating outfits; a folder called "The ABC of battery charging"; circular No. 1156 describing type S and type R direct current generators, with profuse illustrations; and publication 1525 describing Baldwin-Westinghouse electric mining locomotives, also fully illustrated.

A.C. Motors.—Pamphlet No. 22A issued by Bruce, Peebles & Company, Limited, Edinburgh, describing the Peebles alternating current motors, polyphase type. The pamphlet is divided into two parts, the first dealing with open type machines and the second with a very compact form of motors made in fairly large sizes with bearings self-contained. These latter motors are specially suited for direct coupling to fans, pumps, and similar apparatus.

Overhead Runways—Bulletin No. A-12 issued by the Herbert Morris Crane & Hoist Company, Limited, Toronto, describing, with illustrations, some very interesting, recent installations made by this company. The Morris runway is shown in the warehouse, paper mill and foundry, and the modifications of the equipment to suit varying conditions is indicated in a very interesting manner.

Current News and Notes

Amherst, N.S.

The committee on street lighting have placed an ornamental pole, carrying a cluster of tungtens, on the main street for observation purposes as it is the intention to improve the street lighting at an early date.

Belleville, Ont.

It is expected that work on the installation of a new street lighting system will be commenced almost immediately.

Biggar, Sask.

The municipal council are considering the question of a municipal electric plant but have not yet decided whether they will give a franchise or build and operate a municipal plant.

Brantford, Ont.

The city council has passed a by-law authorizing the issue of debentures to the amount of $70,000 for hydro-electric extensions.

Buckingham, Que.

The municipal council are contemplating the installation of an electric lighting system.

Bury, Que.

The Westbury Heat, Light & Power Company are negotiating with the municipal council of Bury regarding a 20 year franchise to furnish electric energy to the municipality.

Calgary, Alta.

The Eau Claire & Bow River Lumber Company, Mr. P. A. Prince, manager, are installing an addition to their water power plant which consists of two 50-inch Samson turbines. The same company contemplate an addition to their steam plant and expect to add gas engines to develop 1500 kw. This company is closely associated with the Calgary Water Power Company.

As a result of a considerable surplus shown by the Electric Light & Power Department of Calgary the rates have been reduced by between 6 and 7 per cent.

Cannington, Ont.

Tenders are called for transformer equipment at this point by the Hydro-electric Power Commission of Ontario.

Drumbo, Ont.

By-laws were recently passed authorizing electric supply agreements with the Hydro-electric Power Commission of Ontario in Drumbo, Glassville and Princeton.

Edmonton, Alta.

The Lacombe & Blindman Valley Railway Company are desirous of increasing their borrowing power to $30,000 per mile.

The Western General Electric Company, Limited, have increased their capital from $100,000 to $500,000.

Fernie, B.C.

Rates in Fernie have been reduced from 15c per kw.h. to 14c with discounts varying from 15 to 40 per cent., the latter being given if over 750 kw.h. per month are used; a meter rate of 15c a month for residences and 25c a month for other purposes is charged. The power rate varies from 12c down to 2c per kw.h. The 2c rate is given if over 1800 kw.h. are used in any month; an extra 10 per cent. is allowed for prompt payment.

Glencoe, Ont.

The municipal council of Glencoe have approached the Hydro-electric Power Commission of Ontario and will get a report on the cost of supplying light and power.

Goderich, Ont.

The Marine Department of the Dominion Government have decided to install a powerful electrically operated fog-horn at Goderich.

Hamilton, Ont.

The Standard Underground Wire & Cable Company have been awarded a contract for 60,000 lbs. of copper wire required by the Hydro-electric Department.

Tenders will shortly be called for 500 standards and lamps.

Tenders are called to February 15 for a year's supply of meters of various sizes amounting to between 4,000 and 5,000.

Hull, Que.

The extension of the electric railway to Gatineau Point is being considered.

Kisbey, Sask.

The South Kisbey Rural Telephone Company have been authorized to spend $6,500 in construction work.

Kingston, Ont.

It has been stated by the Canadian Northern Railway Company that they will probably place a gas-electric car on their line between Harrowsmith and Kingston.

The Napanee Improvement Company have made a proposition to the Kingston council regarding the supply of cheap electric power from a suggested development at a point known as Third Depot Lake where there is said to be from 1,000 to 2,000 h.p. available. The communication was made to the council through Mr. A. W. Benjamin, of Yarker.

Lindsay, Ont.

The Electric Power Company recently chartered a special train to carry a number of prominent officials of Belleville, Campbellford and the intermediate districts to inspect the new system of magnetite arc lighting on Kent Street, Lindsay. The visitors were greatly pleased with the Lindsay installation and satisfied that it would meet their own requirements. The Electric Power Company place their engineering organization, free of charge, at the disposal of any municipality that may have electrical problems in wiring, lighting or power extensions.

Lacombe, Alta.

A contract has been awarded to the Canadian General Electric Company for a 100 kw., 2300 volt, 3 phase, 60-cycle, 277 r.p.m. engine driven generator.

London, Ont.

At the annual meeting of the London Street Railway Company the matter of purchase of a half-dozen more cars was taken up.

A conference of the various municipalities interested in hydro-radials will be held in London in the near future. It is the intention to issue invitations to all municipalities in the neighboring districts who will send representatives.

Melfort, Sask.

The municipality of the town of Melfort recently placed

their new electrical equipment in commission. This consists of a 150 h.p. Diesel engine direct connected to a 90 kw., 2200 volt, 3-phase, 60-cycle generator. The engine was supplied by the Boving Company of Canada and the electrical equipment by the Canadian General Electric Company.

Merrickville, Ont.

Tenders are called by the Department of Railways and Canals for the construction of a concrete dam. Tenders are received up to February 12.

Montreal, Que.

Norton Griffiths & Company, of London, Montreal, and St. John, N.B., have offered, in conjunction with W. H. Brown & Company, of New York, to organize an operating company with $25,000,000 capital to build a comprehensive system of subways in Chicago. The fare is not to exceed five cents. The surplus profits are to be divided: 55 per cent. to the city and 45 per cent. to the company.

The Montreal council have authorized a loan of $2,000,000 to establish and maintain a municipal electric plant, in connection with the enlargement of the aqueduct, work on which is now being carried out. It is proposed to develop 10,000 horse-power, 6,000 for pumping water and the remainder for lighting.

The Montreal Light, Heat and Power Company are completing a ten storey addition to their offices. The exterior is of Indiana limestone with carved frieze and heavy ornamental cornices, which give it a very attractive appearance. The interior woodwork is of solid oak and the corridors and entrance halls are finished with Terrazzo floors and marble dados. The addition is equipped with three electric elevators, one of which is to be a combination freight and passenger elevator.

The Bell Telephone Company will cut in their new exchange on Rockland Avenue, Montreal, on February 28, with about 2,500 lines from the St. Louis exchange.

When market conditions are favorable the directors of Price Bros. and Company will dispose of $600,000 bonds of the subsidiary Shipshaw Water Power Company. The power company's development is at Murdock Falls, about two miles from Kenogami, and the present installation consists of 6,600 h.p. Provision is made in the power station to bring the capacity of the plant up to 10,000 h.p. at a cost of $40,000 for the additional unit. The company has entered into an agreement with Price Bros., by which it sells 5,000 h.p. at $15 per h.p. The water power was purchased and developed by the Jonquiere Pulp Company, and sold to the Shipshaw Water Power Company for $600,000 bonds and $100,000 common stock. Gross earnings of the power company are estimated at $75,000 for 1914, net at $67,000 and surplus after bond interest at $37,000.

Moose Jaw, Sask.

Tenders are called up to February 23 for an electric elevator for a public building to be built here. Tenders are received by the Department of Public Works, Ottawa.

New Glasgow, N.S.

The Eastern Steel Company are installing an electrically driven coal handling plant for the municipal power plant, Regina, Sask.

North Vancouver, B.C.

Mr. J. Findley, chief of the fire department, has recommended the purchase of 30 additional fire alarm boxes.

Niagara Falls, Ont.

It has been recommended by the town engineer that the River Road be lighted for a distance of some two miles with ornamental standards and arc or incandescent lamps.

Nanaimo, B.C.

It is probable the Nanaimo Electric Light & Power Company will require additional generating equipment during the year as the company are making considerable extensions to their distribution system.

Ottawa, Ont.

The Cedars Rapids Manufacturing and Power Company have submitted to the government a plan for a transmission line from their generating plant near Montreal, to Cornwall. It is the intention of the company to make Cornwall a distributing centre for the towns and municipalities in that district.

W. C. Edwards & Company are applying to the Dominion Government for power to extend their charter rights so that they may sell electric energy not required in their own establishment for light and power purposes.

The Department of Public Works recently awarded a contract for the construction of a dam on the French River. This dam is built primarily in the interests of navigation but a considerable amount of electric power will be developed, some of which will be required for the operation of the dam and the lighting of the navigable channels in the immediate vicinity.

Portage la Prairie, Man.

The city of Portage la Prairie are applying to the provincial legislature for an extension to their charter rights sufficient to allow them to erect a transmision line outside the city and to deal in power, etc. The supposition is that these rights may be used to bring power from Winnipeg.

Port Stanley, Ont.

Extensions are contemplated to the government lighting system at this point.

Regina, Sask.

The operating returns of the municipal street railway system for the week ending January 24, 1914, are as follows:—Revenue, $3,889.25; number of passengers carried, 94,601; passengers carried including transfers, 105,439.

Saskatoon, Sask.

The municipality have just added to their generating equipment a 3,000 kw. steam turbo-generator, two-phase, 2300 volts, 60-cycles, 3600 r.p.m., complete with motor-operated field rheostat and remote steam control for the steam turbine. The equipment also includes a surface condenser complete with necessary motor driven air pump and motor driven condensate pump. The equipment was supplied by the Canadian Westinghouse Company.

Simpson, Sask.

The Simpson Rural Telephone Company contemplate the erection of a telephone exchange to cost $10,000.

St. John, P.Q.

The Bell Telephone Company's exchange at St. John, P.Q., has been changed from the magneto to the central energy system.

Stratford, Ont.

A by-law recently passed authorizing the expenditure of $20,000 for further electric extensions.

Strathroy, Ont.

A by-law will be voted on February 16 providing $25,000 for the cost of a distribution system.

Sudbury, Ont.

An ornamental system of lighting on the main streets of the town is being considered at present by the town council. An addition to the power plant is also contemplated.

Smithers, B.C.

The new electric plant was turned on in Smithers on

January 23. This plant is of interest owing to the fact that it is only about four months since the first house was built in Smithers and they now have a plant capable of supplying 4,000 lights.

Sydney, N.S.

The Cape Breton Electric Company's new ferry boat "The Electronic" has just been placed in commission.

Thamesford, Ont.

Hydro-electric light was turned on in the streets and homes of Thamesford on January 27.

Toronto, Ont.

Alderman Dr. Wickett, chairman of the Civic Transportation Committee has stated that the Ontario Railway & Municipal Board will probably act on advice at present being secured by a New York engineer regarding the building of new lines by the Toronto Railway Company.

Governor Glynn of New York State and other state officials are urging the House of Foreign Affairs Committee to allow a diversion of 20,000 cu. ft. of water per second from the Niagara. The present limit is 15,000 cu. ft. per second. The addition would represent a development of between 300,000 and 400,000 horse-power.

Following the mishap to the transmission line of the Hydro-electric Power Commission of Ontario on January 31, it is likely the work of installing another transmission line between Niagara Falls and Dundas will be hastened.

It is reported that the Toronto Street Railway Company are planning to erect two new car barns.

The annual statement of the Toronto Railway Company for the year 1913 shows the gross income to have been $6,049,919, as compared with $5,448,058 in 1912. Operating expenses absorbed $3,123,308, leaving a net of $2,925,710, as compared with $2,581,500 the previous year. The gross earnings of the Toronto & York Radial Railway are given as $584,491, as compared with $492,923 in 1912. The gross assets of the Toronto Railway Company are placed at $21,748,605. After paying all charges including percentage on earnings, bonds, interest and taxes there is a surplus on hand for the year of $1,633,812, and after deducting interest on the common stock amounting to $879,958 there is a surplus to carry forward of $753,854. Added to the balance carried forward from the previous year of $3,694,757 the total surplus now brought forward amounts to $4,448,611.

Vancouver, B.C.

The Granby Mining & Smelting Company's new plant at Hidden Creek is reported to have begun operations. The equipment includes an electric tramway line and a hydro electric power plant.

J. S. McDonald, of Eau Claire, Wis., is said to be considering the establishing of an iron and steel plant in Vancouver where they will manufacture, among other things, gas-electric equipment.

For tapping his service wires so that current consumed was not registered on his meter, a customer of the B. C. E. R. Company has been fined $500 with an option of six months' imprisonment.

Vernon, B.C.

It is announced by the local manager of the Okanagan Telephone Company, Mr. G. H. Dobie, that trunk lines will be completed by next autumn so that conversation between the Okanagan Valley and coast cities will be possible.

Windsor, Ont.

The Hydro-electric Power Commission of Ontario have made an estimate of the value of the distribution system of the Sandwich, Windsor & Amherstburg Railway Company in Windsor, placing the value at $155,000, not including the generating station. The report was made in connection with the proposed purchase of this system by the town.

Williamsburg, Ont.

A vote will be taken shortly on the question of a supply of light and power by the Hydro-electric Power Commission of Ontario, from a transformer station to be erected at Morrisburg.

Wolseley, Sask.

The Durham Rural Telephone Company will spend $4,500 on construction work.

Woodstock, N.B.

The county councillors have given consent to the Maine & New Brunswick Electric Power Company to erect their 30,000 volt transmission line through the township to the town of Woodstock. This company develop power at Aroostook Falls, N.B., and will supply power to the municipalities along their new transmission line and in Woodstock.

Welland, Ont.

At the annual meeting of the Niagara, Welland & Lake Erie Railway Company it was announced that work would be commenced shortly on the construction of extensions from Welland to Port Colborne along the lake shore to Fort Erie and thence along the river to Niagara Falls, Ont.

Wilkie, Sask.

It will be some months before the town of Wilkie is in a position to submit a by-law and make the contemplated extensions to their power plant.

Yorkton, Sask.

The town of Yorkton will proceed with the construction of a new power-house immediately, the intention being to have this building ready by the first of July.

Lighting Schedule for March, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Mar. 1	6 20	Mar. 2	5 50	11 30
2	10 10	3	5 50	7 40
3	11 20	4	5 50	6 30
5	0 20	5	5 50	5 30
6	1 20	6	5 50	4 30
7	2 10	7	5 40	3 30
8	3 00	8	5 40	2 40
9	3 30	9	5 40	2 10
10	No Light	10	No Light	
11	No Light	11	No Light	
12	6 30	12	8 30	2 00
13	6 30	13	9 50	3 20
14	6 30	14	11 10	4 40
15	6 30	16	0 30	6 00
16	6 40	17	1 50	7 10
17	6 40	18	2 50	8 10
18	6 40	19	3 50	9 10
19	6 40	20	4 30	9 50
20	6 40	21	5 20	10 40
21	6 40	22	5 20	10 40
22	6 40	23	5 20	10 40
23	6 40	24	5 10	10 30
24	6 50	25	5 10	10 20
25	6 50	26	5 10	10 20
26	6 50	27	5 10	10 20
27	6 50	28	5 10	10 20
28	6 50	29	5 10	10 20
29	6 50	30	5 00	10 10
30	6 50	31	5 00	10 10
31	10 10	Apr. 1	5 00	6 50
		Total Hours		215 40

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Wanted Employment

Partnership. Young man wishes an active partnership. Excellent mechanic, machinist and electrician, with good knowledge of gasoline and steam engines and pumps, also estimating and contracting work. Can invest some capital. Address Box 948, Electrical News, Toronto. 3-4

Electrical and mechanical engineer, Associate A.I.E.E., having executive ability; technically trained with ten years' experience as operating engineer-in-charge of central station plant; marine engineer, estimator in commercial department, manufacturing company and chief assistant to consulting engineer. Gladly give references and further particulars. Address, Box 963, Electrical News, Toronto. 4

Electrical engineer, graduate B.A.Sc., 22, unmarried, with one year's experience, desires position with consulting engineer or manufacturing company where opportunities for advancement are good. Salary secondary. Box 952, Electrical News, Toronto. 3-4

Electrical and Mechanical Engineer, Associate A.I.E.E., desiring a change, wishes to correspond with parties in need of a good man. Is experienced in manufacturing, erecting, transmission, distribution, testing, operation and maintenance. Is at present electrical superintendent for large mining corporation. Address Box 944, Electrical News, Toronto. F

Electrical News
Generation, Transmission and Application of Electricity

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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, March 1, 1914 No. 5

Special Rates for Cooking

It is open to question whether central stations in general are giving sufficient attention to the load that may be developed along the line of electrical cooking. The electric range, in common with many other household current consuming devices, is to be looked upon almost entirely as an off-peak load and as such means pure velvet to many companies and municipalities. The biggest commercial problem that confronts the seller of the electric current is the filling of the valleys in his load curve, and as a consistent day to day "filler" it is doubtful if there is anything to compete with the electric range—except it may be the electric heater which is not yet established on a commercial basis for the average consumer. This being the case we think the central stations should go after the cooking business vigorously, using plenty of their best bait—a low rate of current.

Campare the range, for example, with the electric iron, one of the most generally used pieces of household electric equipment. The iron sells much more readily, it is true, on account of its low price, but it must be remembered that the central station is not in business to make money by selling equipment but by selling current. The average consumption of a sad-iron is only, say, 500 watts and is used, say, two hours a day, one day in the week, consuming 1,000 watt hours per week or 4 kw.h. per month. The range, on the other hand, is used three times a day every day (and often between meals), with a total consumption for an average family of, say, 100 kw.h. per month. The range is thus a 25 times better customer. In addition, its load is distributed pretty evenly over the seven days of the week, while possibly 75 per cent. of the ironing is done the same day, Tuesday, and at approximately the same hour.

The superior quality of electrically cooked food is now universally recognized, but there are three outstanding requisites before the electric range can become general. These are: (1) a reliable range; (2) a range at moderate cost; (3) electric current at moderate cost. The development of a suitable range rests with the manufacturer, and, we believe, there are now a number on the market fulfilling the requirements to a very fair degree. A range at low cost also rests with the manufacturer; it will come with increased demand and, indeed, there are promises that it will come in anticipation of an increased demand—which, to us, looks the better way of doing business. The cost of electric current rests with the central station and, in view of its off-peak nature and the promise of lower price for ranges, we think managers will be well advised in shading their current charges very materially. In different places in Canada rates from 1c to 1½c have been given for some time and the reports are very favorable. The objection sometimes advanced to these low rates—that they discriminate against the poor man—has been proven absolutely fallacious. As a matter of fact, this extra revenue, which is obtained at practically no cost, is taken out of the pockets of the better-to-do customers to the financial advantage of the general consumer.

Electricity and Irrigation

In the daily discussion of the various uses to which electricity can be advantageously put on the farm the question of irrigation seems to have received much too scant consideration. We read the time-worn story of pumping the farmer's water, cutting his feed, milking his cows, or some other more or less impracticable suggestion such as threshing his grain and plowing his fields—these all to be done by electricity so as to make farm life easier and more attractive, but, be it noted, more expensive. Little has been said, however, about the use of electricity to increase the income of the farmer, and this, in all probability, is as interesting a question to him as it is to the average city toiler.

In sections of the country where irrigation has been practiced it has been shown that it is possible to turn lands from a barren, useless condition into fruitful, revenue-producing areas by the constant and judicious supply of water. In western Canada irrigation has met with considerable success and in the western United States the same is true. There are cases where lands valued at less than $20 an acre have by the expenditure of $30 an acre in the installation of a complete irrigation system been given values varying from $150 to $2,000. Intensive farming is not practised in Canada to such an extent as in some of the older countries, but in a modern system of irrigation there seems to be little doubt that the productiveness of the average farm could be increased from 25 to 50 per cent. in the average year and from 50 to 100 per cent. in our worst years. In a word, proper irrigation gives the farmer the control of the rain fall, which, at the present time, is the most irregular and unreliable factor in the production of his crops. It would appear then that the Hydro-electric Power Commission would be well advised in adding this equipment to the list they already advocate for the farmer.

Another point it is well to emphasize is that power used for irrigation may be so applied as to add nothing to the total power bill of the farmer for the year. For example, the irrigation of 100 acres may require, say, a five or ten horse-power motor, but this power need not be used at such time as the power is being used for other purposes, which would also leave all the power available for use around the building during the long winter months when it is all needed there. That is, the load the farmer has around his buildings can be worked in with the irrigation pumping system in such a way that the power contracted for to take care of either can just as well be used for the other system. On another page in this issue we give a brief sketch of one of the most extensive electrically-operated irrigation systems

the world, but in the near future we hope to discuss this matter at greater length and give figures which will indicate more in detail what is being done in this most important industry. After a somewhat detailed study of the conditions the Electrical News is convinced that a much greater benefit will accrue to the farmer at a comparatively small cost than is at present understood by the average tiller of the soil.

Canadian Members of International Congress

In connection with the International Electrical Congress to be held September 13 to 18, 1915, at San Francisco, Cal., U. S. A., during the Panama-Pacific Exposition, the following Canadians have been appointed honorary members of the international committee on Congress organization,—Dr. L. A. Herdt, Mr. Ormond Higman, Mr. A. B. Lambe, Prof. L. W. Gill.

The proceedings of the International Electrical Congress will be divided into twelve sections, relating to the principal branches of electrical engineering, and it is expected that about 250 papers will be presented covering a wide range of topics. The San Francisco Congress of 1915 will be held under the auspices of the American Institute of Electrical Engineers and is authorized by the International Electrotechnical Commission and the Turin Electrical Congress of 1911. The International Electrotechnical Commission will meet at San Francisco during the week preceding the electrical congress.

Great Waterways Union

At a meeting of the executive of the Great Waterways Union, held recently in Berlin, Ont., it was decided to take a large delegation to Ottawa to urge the following measures: —(1) To ask for an ocean waterway of 35 feet from Montreal westward to the head of the lakes, and that the international features of the project be taken up with the United States for the earliest possible determination. (2) To ask the assistance of the Dominion Government in finding means to greatly increase the amount of power in the Niagara Peninsula for the use of the Hydro-electric Power Commission, it being understood that the improvement of the St. Lawrence will of itself supply Eastern Ontario with millions of horse-power, greatly to the benefit of the manufacturers, cities, towns and the farming communities, with the view that Hydro-electric power may become universally used in the Province of Ontario, and for the full benefit of the people, urban and suburban. (3) That the usual Dominion subsidy of $6,400 per mile be given to important projected Hydro-electric railway lines. Private companies have invariably received such aid, and the people's own lines should receive as liberal treatment with the view of encouraging intensive farming, cheaper living, better transportation. Such accommodation wherever supplied has doubled and trebled the value of land.

Severe Test for Generators

Recently in the presence of a number of representatives of central stations, the engineers of a large manufacturing concern deliberately short-circuited a 16,700 kv.a. 8,800 volt generator, running at full speed and without resistance or any other protection in the circuit. Oscillogram records showed that a current of 21,000 amperes, being 12½ times normal, flowed through the generator.

With generators as designed some years ago such a test would have wrecked the machine, but in the present instance no damage whatsoever was done. The only visible effect was a static flash between the field and the armature. The test was performed to prove the fact that generators are being built that require no outside protection from outside short circuits, the generator itself being so designed as to be self-protecting. Unless the generator is properly constructed a complete short circuit tears out the armature coils, which, coming into contact with the revolving field, causes extensive wreckage. Furthermore, the static flash, which always occurs under such circumstances, will destroy inferior insulation. With generators of the type tested, however, both results are guarded against by firmly securing the armature coils and bracing their ends, and by the use of mica insulation. In consequence even so severe an ordeal as this test was withstood without harm, although, we understand, it has been repeated many times with the same machine. In connection with this test several others were carried out in order to prove the reliability of circuit-breakers and reactance coils for protecting the feeder circuits. The generator was repeatedly short-circuited through these devices which stood up admirably under the enormous stresses to which they were subjected.

The practice recommended by the company is to protect the feeders and not the generators. If the generators are protected and a short circuit occurs on any of the feeders, even a poorly designed generator will not suffer; the voltage will fail on all the feeders, all synchronous motors will be thrown out of step, and an overwhelming overload will be thrown on the circuit-breaker of the short-circuited feeder, since it will carry the total curent of all the generators in the station. If, however, protective reactances are placed in each feeder circuit, and a short circuit in a feed occurs, only that feeder will be affected and even then its reactance coil will prevent the current in it from rising to too high a value. The voltage will be maintained at the bus bars and no disturbances will be felt in the remaining feeders; this is, of course, provided that the generators are self-protective; if not, such an event may seriously injure them. It is, of course, possible to protect non-self-protecting generators by reactances, but as the test described above shows, such a proceeding is unnecessary since generators can be supplied that are immune to the worst conditions of load that can be imposed upon them.

Design of d.c. Machines

Professor A. M. Gray, assistant professor of electrical engineering, McGill University, addressed the members of the Montreal Electrical Society on the subject of "The Design of d.c. Machines," at a meeting held in the lecture room of the Engineering Building, McGill University. Professor Gray opened his lecture with the statement that, although a knowledge of the characteristics and operations of direct current machinery is not of as much importance to operating engineers in this country as is a knowledge of alternating current apparatus, yet the field of the d.c. machine is extending, as for instance for long distance transmission by the Thury system, and also for trunk line electrification at 2400 volts.

The characteristics of standard d.c. generators and motors were then discussed, and, in particular, the subject of commutation was taken up experimentally, and the methods of improving commutation by shifting the brushes and by the use of carbon brushes were explained. It was pointed out that the secret of the carbon brush lay in its high contact resistance, and that this generally prevented its application to old machines built with copper brushes. When copper brushes were used the energy lost at the low resistance contacts was slight, and a small commutator was used. If, however, carbon brushes were used on the same machine, the energy lost at the high resistance contacts would cause excessive commutator heating.

The use of interpoles was taken up in the discussion.

In a motor without interpoles the brushes are shifted backwards, so that the coils being commutated are under the pole tips and in a suitable magnetic field; by the use of interpoles the suitable magnetic field is brought up to the coils. Such machines have the advantage that the commutating field increases with the load, and is independent of armature reaction. They will therefore commutate well even when greatly overloaded or when operating with a weak main field such as one finds in adjustable speed machine tool motors, where a speed range of 3 to 1 is required by field weakening.

High speed motors are more difficult to design than those for lower speeds, because the conductors cut lines of force faster, and the voltage between segments is generally greater. That this is admitted by designers may be seen by the fact that high speed motors are generally supplied with interpoles.

The cost of motors for different purposes was touched on incidentally, and, in that connection, the following table is of interest. A motor of a given size could have the following ratings, suitable windings being supplied in each case:

Open type		Enclosed type		Crane & Hoist type		Adjustable speed	
h.p.	r.p.m.	h.p.	r.p.m.	h.p.	r.p.m.	h.p.	
15	375	10	375	35	375*	20	375/1200
20	500	14	500	45	500*	27	500/1200
30	750	21	750	25	375†	40	750/1200
40	1000	28	1000	35	500†		
40° C. rise		50° C. rise		40° C. rise open 50° C. rise enclosed		40° C. rise after 3 hrs.	

* One half hour rating. † One hour rating.

Brantford Will Buy Electric Road

For the past two years the city of Brantford has been involved in litigation with the Grand Valley Railway Company regarding the operation of the Brantford Street Railway System and its allied lines. On account of the wide interest shown in this matter a brief history of the complete situation will be opportune.

In 1902 the city of Brantford granted a franchise to the Brantford Street Railway Company, to run for 50 years, to operate a street railway system in that city. In 1907 this franchise was transferred to the Grand Valley Railway Company, which in the mean time had acquired the assets and property of the Brantford Street Railway Company. The franchise as granted to the Grand Valley Railway Company was amended somewhat and required the building of extensions on a large number of the city streets, amounting in all to some nine or ten miles, with the reconstruction of the entire system as it existed in 1907. The city claimed that the Grand Valley Railway Company had not observed the terms of their agreement, and therefore forfeited their franchise. Action was accordingly brought in 1912 and judgment for forfeiture was given in 1913. The company appealed later in 1913 but their appeals were dismissed. They were however allowed a reasonable time in which to fulfil certain terms of the original agreement. On February 6, 1914, the company applied for extension of time to fulfil these optional conditions imposed by the last judgment or, failing that, to endeavor to find a purchaser for the road.

The city of Brantford at this point decided it would be better to put in a bid for the property at once. This they did and along with another bid from Mr. W. P. Kellatt the tenders were considered during the second week in February and the property allotted to the city of Brantford at a price which is understood to be approximately $250,000. The property included in this contract is the total rolling stock and lines within the city and the lines between Brantford and Galt, a total in all of about 40 miles. A by-law will be submitted to the Brantford ratepayers at an early date authorizing the execution of this contract.

The above sum includes a first mortgage of $125,000 which would have to be taken care of first. Of the remainder, after paying city taxes and bond interest in arrears, there remains about $96,000, which would be all there is left to take care of $59,000 first mortgage bonds and $1,700,000 second mortgage bonds of the Grand Valley Railway. It has yet to be decided by the courts whether this first mortgage ranges prior to the second.

Irrigation Electrically Operated

The largest motor-driven irrigation pumping plant in the world has just been completed for the Crane Falls Power & Irrigation Company, Idaho, by the Canadian consulting engineering firm of Smith, Kerry & Chace.

This district is known as the Glen irrigation district and comprises an area of 30,000 acres, in the valley of the Snake River, having an altitude of approximately 2,300 feet above sea level. Since May, 1913, this area has been rendered fruitful by the use of water taken from the Snake River, lifted by means of electrical pumps into canals on an elevated plateau by means of two pumping stations which include nine motor-driven pumps arranged in four batteries.

Three pumps lift the water to an elevation of 175 feet, two to an elevation of 100 feet, two to an elevation of 60 feet. In another smaller station two more pumps raise the water 104 feet.

The entire output of the nine pumps is approximately 300,000,000 gallons per 24 hours, which, allowing 75 gallons per head, would supply almost 3,000,000 people. To operate the system at full capacity requires approximately 6,000 h.p of motors.

The reasonableness of such a proposition has been demonstrated by the fact that the total expense of this installation, which results in the production of 30,000 acres of wonderfully fertile land, has been made at a cost calculated at something less than $28 per acre. A brief description follows, which, in view of the considerable efforts being made in Canada in the same direction, will be of considerable interest to the engineer.

The system consists of four main canals supplied through wood stave pipes varying in size from 4 ft. 6 in. in diameter to 3 ft. in diameter. In all there are 9,662 lineal feet of pipe, some of which operates under a pressure as high as 75 pounds. The four canals are known as A, B, C, and D. Canal A supplies a territory of 11,760 acres and has 1,225 stations 100 feet apart; canal B covers 7,916 acres and has 693 stations 100 feet apart; canal C covers 6,244 acres and has 596 stations 100 feet apart; canal D supplies an area of 2,805 acres and has 176 stations 100 feet apart.

Station No. 1, the largest of the two pumping plants, as stated above, contains seven pumping units which feed the A, B and C canals. The A pumps, of which there are three 18-in. sets, each discharge 38 cu. ft. per second against a 177 foot head and are driven by 1,100 h.p. motors. Canal B is supplied by two 20-in. sets, each delivering 43 cu. ft. per second against 108 ft. and driven by a 750 h.p. motor. Canal C is also supplied by two 20-in. units discharging 30 cu. ft. per second against a 70 ft. head and driven by a 350 h.p. motor. In station No. 2 the equipment consists of two 14-in. units each, discharging 16 cu. ft. per second against 110 ft. head into canal D.

The power for the operation of the motors is taken from a 40,000 volt line of the Idaho Railway, Light & Power Company, and transformed in the two stations down to operating voltage.

Telegraph Statistics for 1913

A copy of telegraph statistics of the Dominion of Canada for the year ending June 30, 1913, issued by the Department of Railways & Canals is just to hand. The report shows that 9 land telegraph companies are now operating in Canada as follows:—Anglo-American Telegraph Company, Canadian Northern Telegraph Company, Canadian Pacific Railway Company's Telegraph, Dominion Government Telegraph Service, Grand Trunk Pacific Telegraph Company, Great North Western Telegraph Company of Canada, North American Telegraph Company, Temiskaming and Northern Ontario Railway Commission, Western Union Telegraph Company. In addition the following cable companies made reports: Anglo-American Telegraph Company, American Telegraph and Cable Company, Commercial Cable Company, Direct United States Cable Company, Halifax and Bermudas Cable Company, Pacific Cable Board. In addition to this the Marconi Wireless Telegraph Company, which is in a class by itself in that it operates on neither land nor water, submitted a report.

Province.	Pole Mileage.		Wire Mileage	
	1912.	1913.	1912.	1913.
Nova Scotia	2,828	2,907·25	9,878	9,412·49
New Brunswick	1,867	2,251·25	8,376	7,297·34
Quebec	7,515	7,035·25	24,249	25,242·20
Ontario	10,514	11,166·90	58,207	47,682·55
Manitoba	3,803	3,808·00	18,184	13,697·10
Saskatchewan	5,382	5,863·65	21,257	19,499·80
Alberta	2,895	3,476·05	14,491	16,193·05
British Columbia	3,467	5,838·14	10,571	13,192·46
Yukon	2,498	688·00	2,713	688·00
Newfoundland	14	14·00	14	14·00
	40,785	43,048 49	167,939	152,918 99

The report includes interesting figures with regard to the capitalization, gross and operating expenses, salaries, etc.; also with regard to the mileage of the land operating companies. The facts with regard to pole and wire mileage in 1912 and 1913 are shown in the accompanying table. The total wire mileage is 152,919 miles.

Telephone Statistics for 1913

Telephone Statistics for the Dominion of Canada for the year ending June 30, 1913, have just been published by the Department of Railways & Canals and show a marked increase in the use of telephones within the last twelve months. The report states that as far as these figures are complete there is one telephone now in use in Canada for every 16.2 persons and it is thought that if absolutely complete figures had been received this number would be lowered to possibly 15. The total number of organizations which made statistical returns to the department was 1,075. The report states that there are over 100 organizations known to the government from which replies were not received and that there are probably a considerable number of smaller organizations of which the government has no direct knowledge. It is evident, therefore, that the total number of telephone companies at present operating in Canada would be 1,200 or possibly 1,300 altogether.

The character of the various telephone organizations varies considerably in the different provinces. In Alberta the telephones are operated by the provincial government as one comprehensive system. In Manitoba this is practically the case, but there are a number of telephone companies still operating. Saskatchewan, while having its government system, has also a very large number of small stock companies. In Ontario and Quebec the situation is pretty well controlled by the Bell Telephone Company, especially in Quebec. In Ontario the number of stock companies and co-operative companies has increased rapidly so that Ontario's total of telephone organizations is greater than in any other province of the Dominion. In British Columbia the situation is pretty well controlled by one large company as is also the case in the Maritime provinces. The table herewith explains the distribution in the various provinces very fully.

Province.	Government.	Municipal.	Stock.	Co-operative.	Partnership.	Private	Total.
Nova Scotia	......	......	21	28	17	17	83
New Brunswick	......	......	12	3	1	9	25
P.E. Island	......	......	1	......	......	......	1
Quebec	......	......	44	26	3	28	101
Ontario	1	38	143	148	41	80	451
Manitoba	1	7	5	14	1	7	35
Saskatchewan	1	5	304	42	......	9	361
Alberta	1	1	1	......	......	......	3
British Columbia	......	1	12	1	......	1	15
Total	4	52	543	262	63	151	1,075

The report shows that there are now 1,092,587 miles of wire in use with 463,671 telephones. The gross earnings in 1913 were $32.13 per telephone, and operating expenses $24.10 per telephone. Capitalization works out to $129.13 per telephone. Of the total number of telephones in use 269,843 are central energy type and 193,828 are magneto type. The report contains the names of, and a quantity of interesting information regarding every telephone organization in Canada.

Shawinigan Presents Good Report

During 1913 the gross earnings of the Shawinigan Water and Power Company were $1,690,882, an increase of $121,211, while the net earnings of $1,473,439 were $99,719 higher. Operations and maintenance and general expenses amounted to $217,442. The interest on first mortgage bonds, debenture stock, together with general interest, aggregated $501,360, leaving a net revenue of $972,079, which with the balance brought forward from 1912 of $24,281, left available for distribution the sum of $996,361. A dividend of six per cent. was declared.

Mr. J. E. Aldred, president of the company, in the course of his report at the annual meeting, stated: "With the completion of the addition to the company's two plants at Shawinigan Falls, now under construction, we shall have made the largest single increase in capacity ever undertaken by your company. This installation consists of three additional units of a total capacity of 45,000 h.p. The transmission system of your company has also been materially strengthened by the building of a second transmission line of the steel tower type to the city of Three Rivers, which city continues to develop as a market for power. The amount of power now being transmitted over the company's transmission system to Three Rivers and the Asbestos district approximates 20,000 h.p., which is about fifty per cent. of the amount being transmitted over the company's system to Montreal and vicinity (45,000 h.p.)."

Mr. Aldred also reported satisfactory progress with the Cedars Rapids development, which, he said, was being carried out in a most creditable manner under the direction of the chief engineers of the Shawinigan and Montreal Light, Heat & Power Companies. He added: "It is confidently expected that to the extent of one hundred thousand horsepower this plant will be completed within the time originally estimated, January 1, 1915, and further, that with

the development complete and machinery installed to this capacity, the cost will be kept well within the estimated amount provided for this purpose. The putting into operation of the Cedars Rapids plant will still further strengthen the position of your company and its allied companies, in their field of operation. While the supply of power to Montreal will be augmented by the utilization of the Cedars plant, this will allow your company greater latitude in the sale of its power at points within easier reach of the power plant at Shawinigan Falls."

The company have interests in ten subsidiary concerns, four of which, the North Shore Power Company, the Laval Electric Company, the Continental Heat & Light Company, and the St. Maurice Light & Power Company, were, said Mr. Aldred, auxiliaries of Shawinigan, distributing power from the main generating plant in various districts covered by the company's operations.

The retiring board of directors was re-elected as follows: J. E. Aldred, president; Thomas McDougall, chairman; R. M. Aitken, H. S. Holt, John Joyce, Sir William Mackenzie, Sir M. Mitchell-Thomson, Bart., Denis Murphy, Howard Murray, Julian C. Smith, W. R. Warren, E. R. Wood. Several changes were made in the executive, Mr. T. McDougall, the former vice-president, being elected to the new office of chairman of the board of directors. Mr. Howard Murray, formerly treasurer, and Mr. Julian C. Smith, formerly chief engineer and general superintendent, were elected vice-presidents and will have charge of the business and the operating departments respectively. Mr. W. S. Hart, formerly secretary, was appointed treasurer, and Mr. Jas. Wilson, formerly accountant, becomes secretary.

Winnipeg Electric Annual

Sir William Mackenzie in presenting the annual report of the Winnipeg Electric Railway Company for the year ending December 31, 1913, which indicated that gross receipts and net earnings were respectively 8.32 and 3.68 per cent. in excess of the corresponding figures for 1912, reviewed the development work of his company for the past year. The extensions included the following:

18.147 miles of track have been laid as follows: 8.06 miles with 80-lb. rails with concrete foundation and asphalt pavement; 9.341 miles of surface track with gravel ballast; which includes a new line to the Manitoba Government's new Agricultural College, in the municipality of St. Vital.

Forty large double truck closed motor cars, 45 feet long, with wide vestibules equipped with air brakes and all other modern appliances to ensure the comfort and safety of passengers and trainmen, were constructed in the company's Winnipeg shops and put in service.

In extension of the company's electric lighting and power distribution system, there were erected 2,123 additional poles and 395,070 lbs. of wire, in addition to which the company has put down 386,312 duct feet of underground ducts and installed therein 114,440 feet of underground cable leading from the company's Mill street sub-station along Portage Avenue in the central part of the city to take the place of a large amount of overhead wire.

A brick and reinforced concrete with concrete foundation sub-station erected at Transcona, two storeys, with concrete roof, together with boiler room and heating apparatus. Installed in this building are 6,000 kw.'s in transformers, and switching apparatus with available floor space for two motor generator sets.

A brick and reinforced concrete addition to the Mill street sub-station, 40 by 60 feet, two storeys, with concrete roof and concrete foundation, and installed in this building 6,000 kw.'s in transformers and switching apparatus.

A four-storey reinforced concrete fireproof building erected on Assiniboine Avenue, to be used for the storage of gas stoves and gas appliances, and as an electric and gas meter repair and testing shop, with space provided for the use of the Dominion Government in testing meters. The ground floor is used as a garage for the storing of the company's electric and gasoline tower and service wagons and trucks. A charging set has been installed there for charging electric automobiles and cartage trucks for the public.

Adjoining the company's Mill street sub-station the company have constructed a brick storage battery house, 41 by 194 feet, in which has been installed a 6,000 ampere hour storage battery, for storing electric current when the demand is light to be used during the time the demand is heavy, and also as a protection against any interruption that may occur at the generating plants or the transmission line. This plant, when charged, is capable of taking care of the company's railway system in the central part of the city for a considerable time without assistance from the generating plants.

A reinforced concrete sub-station constructed at the Canada Cement Works, South Winnipeg, and installed 4,200 kw. transformers with the necessary switching apparatus

A 22,000 volt transmission line constructed from the Canada Cement Company's plant to the new Agricultural College in the municipality of Fort George, a distance of 6.1 miles from the cement works, and 1,500 kw. transformers installed at the new college.

The company's new ten-storey fireproof office building, which was commenced in June, 1912, is now completed and occupied, and is the most modern and up-to-date fireproof office building in Canada; the company occupying the basement and the first two floors.

Among the large contracts closed by the company during the year 1913 are the following: with the Manitoba Government for lighting and electric power at the new Agricultural College Farm and College Buildings; with the Canada Cement Company for electric power for their new manufacturing plant at West Winnipeg, which has a capacity of 4,000 barrels of cement per day; with the Canadian Pacific Railway Company for electric lighting and electric power for their new shops and roundhouses at North Transcona.

During the year 1913 your directors have been granted franchises and have made contracts for new railway lines in the municipalities of St. Vital and Fort Garry, which are adjacent to Winnipeg, and for electric lighting and electric power privileges in the municipality of St. Vital, and in addition, have made contracts for street lighting in the municipalities of Assiniboia and St. Vital.

It has since been announced that the J. G. White Engineering Corporation of New York have been engaged to make surveys and design plans for the new hydro-electric development on the Winnipeg River.

Important Resolutions

At the fifth annual meeting of the Commission of Conservation a number of important resolutions were passed dealing with the preservation of our natural resources. One of the most important dealt with waters and water powers and read as follows:—

Resolved that all possible information respecting the waters in Canada, connected directly or indirectly with boundary waters, should be collected and digested.

Resolved that as accurate data respecting the flow of streams is absolutely necessary in developing water-powers, all existing information respecting gauge readings, measurements of stream flow and other cognate data in the possession of the Dominion Government, the Provincial Government, corporations and individuals should be collated and published.

Power Distribution for Manitoba

Extracts from a comprehensive report just submitted to the Manitoba legislature on the generation and distribution of hydro-electric power

By Commissioner Robson

Commissioner Robson has just submitted his report to the Manitoba Government on the practicability of power development and distribution, from Winnipeg River, for the general use of the province of Manitoba along lines somewhat similar, it is presumed, to the scheme of the Hydro-electric Power Commission of Ontario. This report was made in compliance with a resolution passed at the last session of the Manitoba Legislature. In compiling his figures, Mr. Robson has based them on the summary of water powers of Manitoba, recently made by the Water Power branch of the Department of the Interior, Ottawa, and on figures relating especially to transmission line costs submitted by Mr. W. E. Skinner, acting for the Board of Commissioners. The cost of development in transmission as determined by Mr. Robson can scarcely be considered favorable or likely to arouse any particular enthusiasm for the immediate prosecution of the general scheme of distribution. It is probable the Commissioner has taken a somewhat unfavorable view of the situation, especially as such a scheme would invariably be followed by a very unusual industrial development which would greatly increase the demand for power and thus reduce the cost figures. This has been the experience of the Ontario scheme, where the demand for power has very much exceeded expectations. The figures given in the report are nevertheless exceedingly interesting, and we reproduce sections of it herewith.

"Of outstanding importance is the report of the water powers branch of the Department of the Interior, which was prepared by the officials of the water powers branch for the purposes of this inquiry. It has already been transmitted to you. Any careful reader of that report will at once be struck with its fullness and detail. It is difficult to appreciate the magnitude of the labor of its preparation. Its cost was wholly borne by the Department of the Interior, and I am told it has involved altogether an outlay of about $60,000. The undertaking of such an investigation and report independently of that department would have been impossible in the time that has elapsed, and it is likely that the expense alone would have been prohibitive of any such exhaustive study by this province, at this juncture.

"It is to be observed that the resolution contemplates electric service throughout the province. The expression is 'for all sections of the province, rural as well as urban.' The reports herewith, and this memorandum, have been prepared with this generality of the projected system in mind. Certain parts of the province, even occupied parts, cannot be reached by such a system. But in view of the breadth of the resolution, the study was undertaken with a view to covering the province wherever that would be at all practicable. Such a study is, in short, an experiment by assuming a hydro-electric system of certain capacity with transmission lines and distribution apparatus and equipment, and then estimating the market within reach of the lines, thereby ascertaining roughly what the cost of power would be delivered within reach of the consumer.

"The general subheads under which an inquiry of this nature distributes itself include (1) the available source of power, that is, the possible river development; (2) the cost of river development; (3) the transmission to distributing centres; (4) distribution; (5) the demand; (6) fixed charges, probable operating costs and the revenues; (7) general observations.

Available Source of Power

"There is already a general acquaintance with the facts as to the existing water powers of Manitoba. Those on the Winnipeg river are notably feasible and capable of immediate development. The well-known city of Winnipeg and Winnipeg Electric Railway hydro-electric plants form existing developments on that river.

"The total possible power development of the Winnipeg river in Manitoba (according to the Water Powers Branch reports) on a basis of 20,000 second feet regulated flow, including the ultimate supply of the city of Winnipeg plant, placed at 76,800 horse power, and the present development of the Winnipeg Electric Railway Company's plant at 26,500 horse power, is 409,700 horse power at a 75 per cent. efficiency basis, as shown in the water powers branch report.

"The total power required to supply the city of Winnipeg at an approximate population of 250,000 is in the neighborhood of 47,300 horse power, or 35,285 kilowatts. Taking these figures as a basis for ultimate requirements, the total possible power development of the Winnipeg river would be reached when a population of approximately 2,165,500 had been served.

Winnipeg River

"These figures demonstrate that the relation of the Winnipeg river to Winnipeg will be of increasing importance, and that consumption equal to its whole development may result in Winnipeg alone. With an electric service for now occupied parts of the province also in mind, it is obvious that general demand in Manitoba will ultimately require the whole of the force to be found on that river.

"The water powers branch has gathered voluminous data regarding the northern rivers, but it is out of the question at present to expend large sums in the engineering work necessary for the estimating of costs of actual adaptation of the falls there for power purposes. That they will eventually exert an immense influence on northern development cannot be doubted, but owing to the distance from population they are not likely to be harnessed up immediately. As will be remarked hereafter, it would seem that the northerly area of the now settled portion of this province cannot, in the present stage of the art, be reached with power from the Winnipeg river. Were a source of power for that area sought, it would be found in the Grand Rapids, where the Saskatchewan river flows into Lake Winnipeg. At this writing there has not been time, even if the cost were authorized, to undertake the work of estimating the cost of development at those rapids, but it can be said with general knowledge of the cost of development transmission and distribution, that there is as yet no market to justify the installation of a hydro-electric service for that area from that power source. In present conditions, therefore, is does not appear to the undersigned to be expedient to advance further with this inquiry as to the river powers in the far north or at Grand Rapids. The possibilities of economical use of the Winnipeg river, situated as it is nearer population, bring the proposal close to feasibility, and this report, therefore, becomes narrowed down to considerations involving the Winnipeg river.

"As above stated, there are seven water powers on the

Winnipeg river in Manitoba, described in the report already mentioned. Three of these are left out of present consideration. They are, the two already developed, i.e., the city of Winnipeg's power at Point du Bois[1], the Winnipeg Electric Railway Company's[2] plant at Pinawa Channel, and the Big Bonnet[3] falls, now said to be in the hands of the Winnipeg Power Company, and intended for immediate use. Of the remaining powers, certain may be subject to outstanding rights, but are in the dormant class. What is said here is subject to those rights.

Distribution

"While the location of possible hydraulic plants is practically determined by the presence of the rapids, the courses of transmission and distribution lines are just now merely suggestive. All that can be done is to project lines through what would be, as well as can now be defined, the area of demand. Subject to similar remark is the estimate of cost. Actual surveys could not be made merely for this preliminary view of the question. Construction difficulties now unforeseen might well arise and increase cost. The extent of much of the necessary expenditure cannot now be made much more definite than estimate, justified as well as possible by experience in other ventures. All work of this nature, labor, machinery and material, is subject to frequent change owing to state of demand and market and variance of device. It is necessary that an attempt be made in the way of projection of line and sub-stations in order to base some idea of the cost of such a public service system as is in mind, and the best has been done in that direction that the limited time and data will permit. It is subject to these conditions and uncertainties that the estimates contained in Mr. Skinner's report now submitted have been prepared. To illustrate the report certain maps showing projected transmission and distribution lines accompany it. While the source of the river power is shown on the map as Pine Falls[4], the cost will be relatively the same in respect of any available location, as there is no great difference in distance.

"The course of the projected transmission line, which was in contemplation by Mr. Skinner in framing his report, is from Pine Falls to Winnipeg, thence making a loop through Portage la Prairie, Brandon, to a point near Minto, thence through Roland and Morris to Winnipeg. This line would, it is supposed, be at 110,000 volts. From Brandon to Hartney, and also from Brandon to Wawanesa, would be transmission lines at 60,000 volts. Branching from high tension sub-stations at these points named are 15 transmission lines of 30,000 volts, covering altogether 525 miles, for the purpose of reaching the various sub-stations through which the consumer is to be supplied.

"At the various community centres, which the 60,000 volt and the 30,000 volt lines would touch, would be located additional sub-stations to convert the voltage at either 6600 or 2200 volts for delivery to the towns, villages and rural districts.

"The total estimates in river work, transmission lines and sub-stations, as estimated in the water powers branch report and Mr. Skinner's report, is $9,902,109.

"After the power has been delivered to the various towns and villages along the route, the problem of local distribution must be considered.

"In such public undertakings the usual method is for transmission of power in bulk, as it may be termed, to municipalities, who themselves take charge of the local distribution. The projected transmission lines were drawn with the idea of reaching population within reasonable limits. For this purpose, to serve all who would be within reach of the scheme would require, it is thought, forty sub-stations. The estimate of $9,902,109 ends with the work at these sub-stations. To carry the power from the sub-stations to the consumer would, it is estimated, cost the municipalities $1,455.30 per mile of line.

"In addition to the cost of rural distribution, however, it must be remembered that each farmer must supply, in addition, his own transformers, house wiring, motors, etc. This cost will vary from $200 to $1,500, depending on each consumer's requirements. The total number of rural consumers, as estimated, is 6,000. In the four districts shown it was found that the average possible consumers per station was 220, based on the number now using telephones within a radius of seven miles of the centre of distribution. As a total of forty sub-stations is proposed, it may be assumed that there will be an average of 150 consumers per station, or a total of 6,000 consumers. Allowing one mile of construction at $1,455.30 per mile for each consumer, the total cost of 6,000 miles of distribution lines would be $8,731,800

"It has been estimated that in 37 towns and villages within range of the projected transmission line there is at present installed approximately 11,000 horse power capacity in steam and gasoline engines and motors. Much of the above power is at present installed to operate mills, elevators and electric light plants. Elevators are only operated during a portion of each year, and the same is also practically true of mills, while electric light plants generally operate throughout the year. The load factor, or ratio of the daily output in kilowatt hours to the maximum possible output, is therefore relatively low.

"The question of the immediate feasibility of the general provincial undertaking depends upon the financial result. The following compilations have been made, and, it is thought, are conservative. They are submitted subject to the qualifications already expressed as to estimates of cost of construction which likewise apply in some degree to cost of operation. The demand is probably given at a figure that would soon be exceeded.

	Investment	Depreciation
Generating station	$3,177,400	$ 63,548
110,000 volt lines	2,545,123	76,354
60,000 volt lines	310,906	9,327
30,000 volt lines	2,575,125	77,254
Winnipeg sub-station, 110,000 volts	134,946	5,398
Brandon sub-station, 110,000 volts	239,520	9,581
Portage sub-station, 110,000 volts	120,832	4,833
Roland sub-station, 110,000 volts	105,213	4,209
Hartney sub-station, 60,000 volts	64,948	2,598
Wawanesa sub-station, 60,000 volts	58,766	2,351
34 sub-stations at $16,745	569,330	28,466
Total	$9,902,109	$283,919
6,000 rural lines at $1,455.30	8,731,800	436,590
Total investment	$18,633,909	
Total depreciation		$720,509
Interest on total investment at 5%		$931,695

"The cost of operating a system as outlined has been based largely on unit costs derived from the city of Winnipeg electrical department report.

Operation of generating stations	$16,000
Maintenance and patrolling—	
952.75 miles of line at $60 per mile	57,165
6,000 miles of rural line	60,000
Operating six high tension sub-stations	18,000
Operating 34 sub-stations	40,800
General office expense	17,500
Commercial expense	20,000
Miscellaneous	15,000
	$271,465

[1] 76,800 h.p. capacity; 20,800 h.p. developed.
[2] 66,500 h.p. capacity; 26,500 h.p. developed.
[3] 95,500 h.p. capacity.
[4] 63,100 h.p. capacity.

Cost per kw.h.

"The total annual cost per kilowatt hour on the distribution lines, and without taking into consideration cost of consumers' installation and connection with the system, is brought out at the following figures:

Depreciation	$720,509
Interest	931,695
Operation	274,465
Total	$1,926,669

"The estimated consumption, as above noted, is 8,308,320 kilowatt hours, and on the basis of, say, 10,000,000 kilowatt hours' output, the unit cost per kilowatt hour would be about 19.27 cents.

"The total annual cost to towns and villages only will be approximately as follows:

Depreciation	$283,919
Interest	495,105
Operation	177,580
Total	$956,604

"At an annual output of 5,908,320 kilowatt hours the unit cost to towns and villages only will be about 16.2 cents per kilowatt hour, which is undoubtedly greatly in excess of the present price for which they are generating their own power individually.

"The above figures in neither case provide for the cost of local distribution in towns and villages.

"Until such time as the development of the province will warrant building long transmission lines, it seems that the cheapest power for farmers obtainable must come from small gasoline installation, unless it is desired to promote the industrial development of the province by carrying a heavy deficit for a considerable period of years. It is clear that a general hydro-electric undertaking for the provision of electric service merely for the use of the agriculturist could not be accomplished on any satisfactory financial basis, and that such a scheme would depend on the growth of towns and villages, which would make such a demand for power as to give a foundation for the enterprise.

"The resolution of the legislative assembly points to the beneficial results in Winnipeg of the establishment of a publicly-owned and operated hydro-electric system. Conspicuous is the impetus to manufacturing in that city. The resolution seemed to have proceeded from the hope that all other sections, rural and urban, might be benefited by a like measure. There cannot be forgotten that there are many towns that, once supplied with cheap electrical service, would experience a stimulus similar in kind, though perhaps less in degree to that so well evidenced in the case of Winnipeg. It is not too sanguine an expectation that the electrical impulse throughout the province would increase local manufacturing and thereby augment population, and not only so, but the demand for power so arising would provide a market implementing the rural demand in such an extent that such revenues would be produced that the financial side of the undertaking would, as growth proceeded, become less formidable.

"There has become current a suggestion of a possibility of transmission into other portions of the province of surplus power to be purchased from the hydro-electric system of the city of Winnipeg. There is evidently a possibility of a greatly increased power development at Winnipeg's hydro-electric site. The city's demands are growing and its present development may soon be fully taxed. The city, however, is about to increase capacity, and will still have a possibility of further development to a very high figure. It should be within reason to expect that measures could be had to utilize that plant to capacity before expending large sums in new development. Such a course would be economical to all interests. There has been no expression of anyone in authority as to possible arrangements to this end, and at present it is nothing more than a suggestion. Without authority to approach the city authorities it is impossible to say on what terms such an arrangement might be made, if at all. To suggest, in this report, arrangements for extension of that plant so as to guarantee a constant supply for a provincial system, would be carrying the matter beyond the present reference. At the same time, I do not think this idea can be wholly dismissed from view.

"Full opportunity was given to the public to make representations upon the subject of this inquiry. It may be repeated what was said in the recent annual report of this commission:

" 'In June the commissioner invited, through the press of the province and by correspondence, the submission of evidence or representations, and intimated a desire to attend at any particular points for hearings on the subject. This elicited very few responses.

" 'Again, in October last, an advertisement was inserted in seventy-six newspapers throughout the province, inviting representations and suggestions upon all phases of the subject, and offering to attend at any community centre to hear persons interested, besides requesting correspondence. The commission's inspector visited all the important points in the province, collecting data touching the number of probable users of light and power in towns and vicinity, present method of supply population, and other facts and information necessary to form a comprehension of the aim and scope of such a far-reaching undertaking.'

"Expressions of opinion of the desirability of such a measure have been general, but almost always accompanied by a doubt as to financial possibility. A desire for further information was generally expressed and it is apparent that there is a growing interest in the subject."

(Concluded from page 48)

phone cannot remain connected when making capacity tests, for the telephone circuit would itself be charged and discharged, due to changes in potential conditions, and the test would be, of course, misleading. It is therefore necessary to avoid having the telephone key operated when making any ballistic test either grounded or metallic. The characteristic clicks received in the telephone due to the charge and discharge of a condenser soon become recognized when heard, and thus act as a guard against a false test.

That British Columbia's development is on a firm foundation is indicated by several items in the February issue of Telephone Talk, the magazine published by the B. C. Telephone Company. Since the company has caught up on its extensive plans of construction, as noted at some length, it is now occupied in many smaller works of progress, and that these are being proceeded with in different parts of the province shows that steady advance is being made. That 1913 was not a bad year with the telephone company is also shown by the net gain of 6,115 stations throughout the province, the net gain in Vancouver being 3,628 and in Victoria 1,392. Net gains were also made in January. Telephone Talk contains some fine full page illustrations of Victoria in the current issue, accompanying a write-up of the capital city. The article contains much information and will be of considerable interest, since much of the text has not appeared before in public print. A large number of items relating to the operations of the company show that it is a busy concern, and that considerable attention is always directed toward improvement of equipment and betterment of the service.

Motor Equipments in a Car Factory

The Canadian Car and Foundry Company Use Electric Power Throughout—Some Interesting Facts and Figures Regarding the Plants

One of the largest motor installations, if not the largest, in Canada, is that of the Canadian Car & Foundry Company, builders of freight and passenger cars of all kinds, at Amherst, N.S. Power is supplied by the Maritime Coal, Railway & Power Company, whose generating station is situated at Chignecto, eight miles from Amherst. The power is transmitted at 11,000 volts from Chignecto to Amherst, where it is stepped down to 2200 volts by the generating company and again for the most part to 220 volts by the Canadian Car & Foundry Company in their own transformers. Mr. Geo. T. Douglas is manager of the car works and we are indebted to him for some interesting information in regard to this extensive plant.

The plant of the Canadian Car & Foundry Company may, as far as electrical distribution is concerned, be divided into three parts, namely:—(1) the old plant; (2) the new steel car, bolster and steel fabricating shop; (3) the malleable iron foundry. The electrical equipment of these sections is described separately in the following article. No more conclusive proof of the general utility of electric drive could be advanced than the very extensive and complete system of motors installed in every part of this plant.

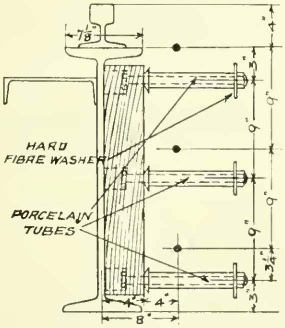

Fig. 1.—Method of supporting trolley wires for cranes.

The Old Plant

In the old plant there are three 40-kw. and three 75-kw. transformers which step the current down from 2200 volts as received from the Maritime Coal, Railway & Power Company's sub-station to 220 volts at which pressure practically all the motors are operated. The motors are supplied by four distinct circuits which it is the intention shall be controlled separately by overload automatic oil switches but the installation of this equipment has been delayed by rush of work as the company has recently been expanding at a very rapid rate. There is also a fifth circuit which takes current direct from the 2200 volt line. This circuit is controlled by an overload automatic oil switch and feeds two 40 h.p. motors which drive a matching mill, as indicated in the list of motors herewith.

In addition to the above power transformers there are also two 40-kw. transformers to take care of the lighting load, which consists of the equivalent of about 2,000 16 c.p. power lamps. The general lighting of the shops is done by 10 amp. flame arc lamps carried in groups of four on small auto-transformers, which reduce the voltage from 220 to 55. The arcs comprise thirty-six 18 hour lamps, and twenty-four 100 hour lamps. They have also six A.B. lamps, with economizers, to run on 220 volts and about 20 direct current A.B. arc lamps run from a 20-kw. d.c. dynamo owned by the car company.

In the woodworking mill where shafting and belts are many and ceilings low, they use four-light clusters with mazda lamps enclosed in opal globes. The current for lighting is distributed in three phase and carried along with the power wires on the same poles and brackets and balanced as nearly as possible in the various shop-loads. General outside yard lighting is accomplished by Benjamin four-light clusters with 100-watt lamps, and pole bracket lamps, controlled from the switchboard in four sections.

A complete list of motors, their capacity, voltage and uses is given herewith in Table 1.

Table I.—Motors in Old Plant

H.P.	R.P.M.	Machines Driven
20	1140	Band and circular saw, pony and buzz planer, wood lathe.
40	1130	2 circular and 1 band saw, 2 boring and 1 gainer, 1 emery wheel, 1 buzz and 1 pony planer.
40	1200	No. 90 Berlin matcher, 4 cut-off and 1 rip saw,
40	1200	also fan.
5	1650	2 cut-off saws.
40	850	Belt sander, also Berlin Invincible sander No. 49.
20	1130	Rotary blower.
20	1200	2 emery wheels, 1 buffer, 1 drill, 3 tumbling mills.
20	1200	6 lathes, 2 punches, 1 emery wheel, 1 planer, small shear, 1 drill.
20	1120	1 Thos. Collins Co. No. 66 shear
15	1120	1 mortise machine.
12	700	1 18-in. cut-off saw, 1 14-in. rip saw.
5	1700	1 emery wheel, automatic re-saw grinder, 1 knife grinder, 1 mortise chain grinder, 1 re-saw lap grinder.
30	850	1 Berlin straight moulder No. 108.
10	1120	1 21-in. and 1 16-in. cut-off saws.
25	1140	1 5-in. re-saw.
1	1700	1 emery wheel.
3	1700	1 elevator.
15	850	1 planer, 2 drills, 2 shapers, 1 milling and slotting machine and 1 emery wheel.
15	850	6 drilling machines, 1 hack saw, 1 emery wheel.
15	850	1 planer.
40	1120	1 No. 7 Sheldon fan.
10	1120	1 fan, No. 3.
30	1130	2 headers, 3 threaders, 1 lag pointer, 1 emery wheel.
5	1700	1 elevator.
5	1600	1 hair picker.
10	1120	1 drill, 1 emery wheel, 1 band saw, 1 wood lathe.
10	1120	1 water tippling mill.
40	850	1 No. 40 double shavings Sheldon fan.
10	1120	2 threading machines, 1 hack saw.
50	810	No. 1 lever shear.
30	1120	No. 9 Buffalo fan.

15	850	1 tapping, 1 threading, 2 drilling machines, 2 shapers, 1 punch.
10	1120	2 pairs shears. 1 threader.
40	850	4 gainers, 1 mortise, 1 buzz and 1 surface planer, 2 circular saws and 1 band saw, 1 chain mortiser, 2 variety moulders, 2 tenon machines.
50	1140	Hot saw.
5	1700	Threading machine.
20	900	1 No. 2 garrison shear.
30	850	Transfer table.

Steel Car, Bolster & Steel Fabricating Shops

In the steel car, bolster and steel fabricating shop, current at 2200 volts, protected by Garton Daniels lightning arresters and isolation switches, feeds, through three pole, no voltage and overload automatic oil switches, three 100 kw. Westinghouse transformers, which deliver 220 volts, divided into four circuits supplying current to motors as per list, through four overload automatic oil switches. The compressor delivering air at 100 lbs. per square inch for use in the above shop is driven by one 375 h.p. slip-ring motor, which runs at 600 r.p.m., belt-coupled, and takes 2200 volts direct from the line through no voltage and overload automatic oil switch. The other motors operate at 220 volts. The switchboard for this shop consists of three marble slabs 36-in. x 48-in. and one 24-in. x 42-in. mounted on angle irons with a clearance of 3 ft. between wall and any cable or switch, leaving plenty of room for inspecting and working behind board.

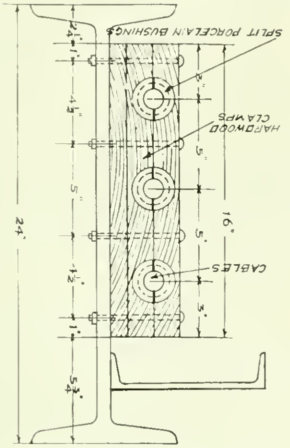

Fig. 2.—Method of supporting cables.

The motor feed cables are 300,000 circular mills, stranded, rubber covered and double braided and are carried in the runway girders on which the overhead cranes run, secured by rack and split insulators every 20 ft. as per sketch, Fig. 1. This we think makes a very efficient job, as the cables are entirely out of the way of getting damaged. The motor feed wires are attached to the cables by clip connectors, to facilitate the quick isolation of shorts or grounds, and led in conduit pipes to three-pole knife switches with two sets of fuses, starting and running, which protect the motor and auto starter. All wires from conduit pipes to motors, switches and starting boxes, where exposed and liable to damage, are placed together and securely bound with marlin, laid on over a layer of strong canvas put on in the form of tape. This forms an effective cushion for any ordinary blow which might be expected from men inspecting on working around machinery. Switchboards are placed on the web of the I-beam columns supporting the building, which, with the box covering, are efficiently protected. All motors on the floor, or liable to damage from small rivets or bolts which are continually being thrown about in a shop of this description, are covered with a strong galvanized iron box designed with due regard to the ventilation of the motor.

The general lighting of this shop, which is 460 ft. x 160 ft., is efficiently carried out by 14 multiple arc lamps, 30 ft. from floor (to clear cranes), 110 volts, fed by a three-wire system 220 volts between the outers and 110 volts between middle and outers, and connected temporarily to the power transformers. The machines are lighted by carbon filament lamps with suitable reflectors. In this section there is also a private fire alarm system, with bells in most departments, all in series, and boxes in parallel. Passenger and dining cars are erected and wired here, the company being at present engaged on 15 Canadian Northern first-class passenger cars, installing the Stone system, including an independent train line circuit to facilitate these cars running in with other systems.

The following list, Table II., indicates the number, size, speed and uses to which the motors are put in this department:—

Table II.—Motors in Steel Shop

H.P.	R.P.M.	Machine Driven.
5	1700	Radial Drill.
30	900	Rotary Planer.
20	900	Mult. Drill.
5		Grinder Machine.
7½	900	Angle Shear.
30	900	Spacing Punch.
5	900	48-in. Gate Shear.
15	900	120-in. Gate Shear.
5	900	No. 2 Punch.
5	900	No. 2 Punch.
10	1200	B. Punch.
5	1200	Horizontal Punch.
7½	1200	36-in. Punch.
10	1200	Bend. Machine.
30	900	"G" Mult. Punch.
50	900	No. 9 Bulldozer.
50	900	No. 9 Bulldozer.
10	1200	"B" Punch.
5	900	No. 2 Punch.
5	900	No. 2 Punch.
30	900	No. 7 Bulldozer.
7½	1200	High Power Drills.
7½	1200	High Power Drills.

At the Malleable Iron Foundry the company have two distributing points, one in the old section, the other in the new extension. At the former, light and power are carried on three 10 kw. transformers taking current at 2200 volts and delivering 220 volts. In the new extension they have three 30 kw. transformers controlled by no voltage and overload automatic oil switches. These need a switchboard with four motor circuits. Motors are as per list herewith, Table III.

15	900	Rivet Machine Drills.
5	1200	Radial Drill.
20	900	Radial Drill. Not Installed.
40	900	Blower.
40	900	Blower.
5	1700	Shear Blade Grinder.
5	1700	Radial Drill.
2 10	1240	Vertical Drills.
10, 10 and 3	—	Gantry Crane.
375	600	Air Compressor.
40, 37½ and 4	—	10-ton bridge crane.
40, 37½ and 4	—	10-ton bridge crane.

Malleable Iron Foundry

H.P.	R.P.M.	Uses.
10	900	Elevator.
15	900	Water Mills.
15	1200	Blower.
25	1200	Blower.
25	850	Tippling Mills.
10	1200	Grinders.
10	1200	Woodworking Machines.
5	1200	Woodworking Machines.

7, 2½ and 2 h.p. slip ring motors—5-ton crane.

The wiring is all open with the exception of where it comes down the walls to the starting switches and motors. The illumination is given by eight eighteen-hour 10 amp. flame arc lamps and thirty A.B. a.c. lamps with economizers to run on 220 volts. An experiment with 250 watt mazda lamps is being carried on here as dust and smoke are features to be taken into account in this department.

The wiring in the new cars is done in accordance with the C. N. R. specifications in steel conduit and Crouse-Hinds condulet fittings. The cars under construction will be fitted with five 4-light and two 2-light branch fixtures down the centre of the car and 4 vestibule lamps; also 3 saloon lamps wired on the outside roof of the car with junction boxes for each of the fittings. These are controlled by a six contact main switch, Stone type, which is part of the system. In the first position of the switch the vestibule, saloon and one light in each of the fittings are switched on; in the second position the rest of the lights in the fittings are switched on; the third position cuts out the lights and short-circuits the auxiliary resistance. The heater room and the switch locker lights are independent of the above switch and are operated by door switches protected by suitable fuses.

Everything connected with this system of lighting is of robust construction. The cells (Tonum) are 9-plate each, 10 13-16 in. x 5 9-16 in. x ⅜ in., of which there are 24 per car,

Fig. 3.—Electrically driven punch in steel shop.

each enclosed in lead lined teak boxes with two stout positive and two negative lugs. The company finds this system admirably suited to fulfil the hard usage of railroad conditions.

Purchased Power and Coal Mining

By Mr. A. E. Rickards*

Purchased power affords so many advantages to the majority of bituminous coal operators that it will probably be only a question of time until most of them will be using it. In the meantime the coal operators must become acquainted with the merits of central station power, and the power companies must first learn how power is used to produce coal economically, and what advantages their service offers over power plants at the mines operated by the coal producer.

The Present Situation

The situation before the average coal operator is such that purchased power will supply a means to assist in solving some of his most difficult problems. These are:—

1—How to increase the production.

2—How to reduce the cost of mining.

3—How to keep the increase in the investment consistent with the increase in production.

Many operators realize that electricity applied to their mines will enable them to increase their output, but are holding off because of the investment required to equip a mine electrically and install generating apparatus. A mine now using steam power and mule haulage can change to electric power at a minimum expense if the electricity is purchased from a power company, since, by so doing, the greatest item of expense (the power plant) is eliminated. In this manner the tonnage can be increased with but a small increase in the capital account. With an isolated plant, the increase in the demand for power per ton of coal mined, as the underground workings are extended, frequently requires expensive alterations and additions in the power house. When central station service is used, additional power can be secured at any time.

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The power required by the average mine to-day is three times greater than the amount necessary ten years ago. With the growing demand for coal from individual workings, the cost to produce it has become greater and the capital necessary has increased still more largely, so that it is becoming increasingly difficult to finance increases or alterations in mine power plants. By purchasing power the tonnage can be increased, the production costs reduced and extensions can be made at a minimum expense. The idea of an isolated power plant is so firmly rooted in the average operator's mind, however, that he must first become acquainted with the possibilities of purchased power.

Power

Power is used in bituminous mines to operate pumps, fans, hoists, haulage and gathering locomotives, gathering reels, coal cutting machines and punchers. A general plan cannot be laid out that will apply to the electrification of all mines. Each type presents a problem in itself and must be specially treated as needed to cover its own peculiar conditions. The following is a general outline of the applications most commonly used.

Small pumps are driven by 250 or 500 volt direct-current motors. They are frequently operated only during the day, and the power supply is taken from the nearest trolley or cutting lines. Larger pumps in many cases are operated at night, or are operated continuously, and are commonly driven by 2,300 volt alternating-current motors. The fans operate continuously and are also driven by 2,300 volt alternating current motors. The principal advantage of this application for the large pumps and fans is that it allows the use of a

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smaller motor-generator set, the losses incurred in transforming alternating to direct current are eliminated, the motor-generator sets may be operated only during the day or at such times as the mines are in operation, and the total capital expenditure is much less. Haulage and gathering locomotives, gathering reels, coal-cutting machines and punchers are driven either by 250 or 550 volt direct-current motors.

Old Methods

The methods used in the early days to mine coal were very primitive. The operation generally consisted of digging a hole in the side of a hill at the outcrop. The coal was undermined with a pick and then forced down with wedges. It was then loaded into small cars running upon wooden rails, and after which the cars were pushed out to the surface by men. As the distances from the surface became greater the work of pushing the cars in and out became quite burdensome. Mules were then initiated into the mysteries of underground haulage. This failtful animal has become so firmly rooted in this occupation that it will be some time before he has become completely supplanted by more economical methods of haulage.

Pumps

The first power required in the early mines was for the water pumps. Unless the entries could be so driven that the mine was self-draining, more or less water would accumulate in the workings, which had to be pumped out to keep the mine in operation. This pumping was at first, and is still, largely accomplished by steam pumps, mostly of the reciprocating type. The steam is generated in a boiler plant located near the pit mouth and then carried underground to the pumps, through steam lines, which are frequently of considerable length. In the hard coal region it is a common experience to see a steam line carried over the surface of the ground for several thousand feet from the boiler plant and then disappear down a bore hole several hundred feet to a pump. Only very poor economy can be obtained under such conditions due to the large amount of condensation, drop in steam pressure and leaks. The reciprocating type of pump taking steam at full stroke is also inherently uneconomical in the use of steam. They often consume 120 to 130 pounds of steam per horse-power hour.

Compressed air is also used to quite a large extent in operating pumps. The disadvantage of this system is that it requires considerable compressor capacity; also it is not as economical as steam although it has the advantage of no condensation.

In the better class of mines the steam and the air pumps are being replaced by electrically driven pumps, thus effecting a considerable saving in the upkeep of the pumps and in the power consumption. The losses in electric systems are comparatively low and the maintenance can be kept low with very little attention.

For small pumps up to 25 horse-power, direct-current motors, geared to duplex or triplex pumps, are generally used because the source of power for them is taken from the nearest haulage or cutting lines. These motors are usually arranged for self-starting and require very little attention. The larger pumps are generally of the centrifugal type and it is the common practice to drive them with alternating-current motors. The practice in some of the large mines is to operate several small reciprocating pumps throughout the mine during the day, pumping into a common sump. The sump is then pumped out at night with large centrifugal pumps, this arrangement improving the load-factor to a considerable extent.

Ventilating Systems

The next department about the mine to require power was the ventilating system. In the early days the operators depended entirely upon natural draft or furnaces. Now a forced or induced draft produced by a power-driven fan has become the most reliable method of ventilation. A large percentage of these fans are driven by steam engine; however, the steam lines are often long and frequently uncovered, so that the steam losses are high.

Owing to the importance of the fan operation, any new method of drive must prove itself reliable before mine operators consent to its use. The electric motor has proven itself most reliable and dependable when applied to a mine fan. It has many advantages over the steam engine as it requires less attention, less repairs, consumes less power and the continuity of operation is more assured.

In applying an electric motor to a mine fan it is seldom possible to use a direct-connected motor owing to the inherent low speed of the mine fan. Belting, gearing and chain drives are the methods generally used, belting being the most satisfactory when the reduction is not too great. Both alternating and direct-current motors are used, the advantages being with the alternating current motor when purchasing electricity, as no transformation is necessary; also with this arrangement the direct-current power equipment can be shut down during a portion of the 24 hours. In some mines the fans are operated at the same speed 24 hours per day, while in others, they are run full speed during the day and at one half speed during the night, on Sundays and holidays. In this way considerable power can be saved. The method used depends upon the locality, and the amount of gas in the mines.

When direct-current motors are used for this work they are usually of the shunt type. By using commutating poles a considerable variation in speed can be obtained by field control at high economy. For constant speed fans driven by alternating-current motors, the squirrel-cage type is used. When two speeds are desired, a double-winding squirrel-cage motor is satisfactory. If a variation in speed is required, a wound-secondary motor must be used with resistance inserted in the secondary circuit to reduce the speed. With this application the economy at low speed is of course low, but as the power to drive a fan varies about as the cube of the speed, the actual power lost is not large at greatly reduced speeds. The motor and control for a mine fan should be as simple and reliable as possible. A properly installed motor-driven fan will operate over long periods of time with practically no attention, beyond an occasional inspection.

Haulage

As coal mines became better developed and the length of the haul increased, it soon become evident that some mechanical method of haulage must supercede the animal haulage, since the expense increased very rapidly, as the length of the haul became greater. Rope haulage was first tried, the rope being driven by a steam engine. There are many conditions to-day where the rope provides the best system of haulage. For the majority of conditions, however, the electric locomotive has proven the most economical and efficient method for both haulage and gathering. Our old friend the mule has been driven from the main haulage in the larger mines for some time and is now making his last stand at the gathering. The average period of service of mine mules is not over four years. The cost for feed, harness, veterinary services and stabling will average 50 cents per day. Adding the cost of the drivers to this, it is not difficult to show a considerable saving by the use of locomotives.

In extremely gaseous mines, compressed air locomotives are sometimes used to advantage. This type of locomotive should be used only when it is impossible to use the trolley type. Its cost of upkeep is very high. The storage battery locomotive, properly constructed and equipped, will prob-

ably be the solution for the gaseous mine. At present its high first cost is a little discouraging.

As mine haulage is in many respects similar to a railway system, the electric locomotive is equipped with much the same type of motor and control. In this country, direct current at 250 or 550 volts is the universal practice. The motors are series wound and in the later types are equipped with commutating poles, which greatly increase the reliability of the motor. This feature, to a large degree, also reduces the cost of motor repairs and consequent delays. The controller is of the drum type arranged for series and parallel operation.

Most locomotives are equipped with two motors, although three motors are sometimes used on large locomotives. Where a heavier locomotive is required than the rails can carry, two locomotives are coupled together and operated in tandem from one controller.

Gasoline locomotives are being tried for main haulage but so far have met with indifferent success.

Gathering

For gathering service two types of reels are used for collecting the cars from the rooms to which the trolley wires have not been extended. The cable reel consists of a single or double conductor cable wound upon a small drum and so arranged that a tension is kept on the cable at all times This cable supplies power to the locomotive and unwinds and winds up as the locomotive moves in or out of the room. The traction reel consists of a small motor-driven winch mounted on one end of the locomotive, and is used to haul cars out of rooms where it is not convenient to use an electric cable reel. This type of reel is best suited to mines where the rooms are worked to the dip and the grades are too severe for locomotives.

For gathering service locomotives ranging from 3.5 to 8 tons are used while for main haulage the weights run from 6 to 20 tons.

Rope Haulage and Hoists

The rope haulage system, previously mentioned, is used on grades ranging from 0 to 90 degrees. In practically all cases they were first operated by steam, although quite a number of gravity systems are in use. Where power is purchased or the hoisting outfit is located some distance from the steam plant, an electric motor is used. A large number of steam haulage systems and hoists have recently been changed from steam to electric drive. For small hoists and haulage, both alternating and direct-current motors are used, depending on local conditions and the kind of power available. For large haulage units or large hoists of slow or medium speed, the alternating-current wound secondary motor is used with a liquid or magnetic controller. For large high-speed hoists, a separately excited direct-current motor is used, taking power from a special motor-generator set, usually equipped with a heavy flywheel, to equalize sudden loads.

Mining Coal

The actual operation of mining coal consists in undermining the coal at the floor and then shooting down the coal above by light charges of powder placed in holes drilled between the under-cut and the roof. As previously stated, in the early days before the use of powder became the practice, the coal was wedged down. This was a slow and very tedious process. The undermining was first accomplished by hand with ordinary mine picks. In fact a large part of the coal to-day is obtained by pick mining.

Among the simplest mechanical means for under-cutting the coal is the compressed air puncher. It consists of a reciprocating chisel operated by air. The operator directs the reciprocating chisel against the coal and an assistant shovels back the fine coal produced, so as to leave a clear opening. This under-cut is about 16 inches high in front and four inches high at the rear and is cut back from four to five feet This wedge shaped cut greatly assists in bringing the coal down with light powder charges without breaking it up too fine.

The compressed air plant to furnish air for these punches is usually located outside the mine near the boiler plant. Motor-driven compressors are operated very successfully with purchased power. They furnish a steady load for a synchronous motor, which in turn can be used for power-factor correction. Whenever possible, the electric drive should be located in the mine because of the inefficiency of transmitting compressed air. Portable compressor plants are sometimes used to help out the main plant and keep up the pressure at the far end of some of the pipe lines.

A combined electric and air puncher is in use which gives the advantage of electric transmission of the energy and pneumatic operation of the puncher. This really can be classed as an electric cutter, giving a wedge shaped under-cut which is not obtained with a chain machine.

Auxiliaries

There is often a considerable amount of power in use on the outside of a mine. This power consists principally of auxiliary hoists, chain haulage, crushers, shakers, elevators, washers, pumps, machine shop, etc. In many cases these auxiliaries are driven by individual steam engines, whose principal virtue is that they give fairly high continuity of operation. These auxiliaries can be easily taken care of in a much better and more economical way by substituting electric motors for the steam engines. In most cases alternating-current motors can be applied, which greatly simplifies the power system.

Lighting

In mines not using electric power no attempt is made to light the outside workings. It has been found however, that some illumination is necessary at all switches, cross overs, partings, pumps and underground fans. The incandescent electric lamp has proven the best and cheapest method of providing underground illumination.

Conclusion

It has been the experience of those mines which have changed over from steam to electricity, that a great saving has been effected and the output has been increased. Of course, after a mine has changed over, the operating force will require a little time to adjust themselves to the new condition. The saving and increase in the output by use of electric power, makes itself most manifest when power is purchased from a central station. The initial investment, and the worry and care attendant on the operation of a sub-station is very much less than with an isolated plant. This is so to such an extent that an operator once using purchased power will rarely, if ever, consider going back to his own power plant.

It is not an uncommon thing, when investigating the power conditions at a mine with an isolated plant, to find that the power generated per ton of output is as high as 12 to 14 kw.-hr., with a corresponding cost for power running from 15 to 25 cents per ton. With the intelligent use of purchased power the consumption should not average higher than 2 to 5 kw.-hr. per ton and the total cost for power should not average higher than 3 to 7 cents per ton of output. In changing over to central station power the greatest care should be exercised in selecting the proper power system and power equipment, to see that the particular arrangement is adopted which will give the best results under the conditions prevailing in the mine.

Testing of Telephone and Telegraph Lines*

By Mr. T. H. Nicholson

Testing Metallic

As before stated, and as will be seen from Fig. 24, the volt-meter is normally across the line, or rather in series with it and the testing battery, and without the necessity of operating any keys, so its relation to the test circuit, and to the line under test must be as shown in Fig. 25, where only the contacts of essential keys are shown. For convenience sake this order of contacts will be maintained, the number given with each contact to refer to the associated key.

Under the conditions obtaining in Fig. 25 no deflection is obtained, indicating that unless the line is actually open, there is no leakage or metallic connection between L_1 and L_2. The next step is to determine if the line or instrument is open or not. This is done by means of a ballistic test, or test for capacity. No change is made in the testing circuit except to reverse the L_1 and L_2 by means of the reverse key No. 3, which alternately charges and discharges any condensers that may be across the line. The charge and succeeding discharge causes a momentary deflection of the voltmeter to the right, the amount of deflection depending on the capacity of line or condensers on it. With a commercial voltmeter of 30 volts range a deflection of about four volts will be obtained on the charge, and slightly less on the discharge. The connections and conditions of the test circuit when making this test is as shown on Fig. 26, where the dotted lines show the reversal of circuit brought about with key No. 3. If this test results in producing a momentary deflection to an extent corresponding to the number of condensers on the line then we know the line is closed through them.

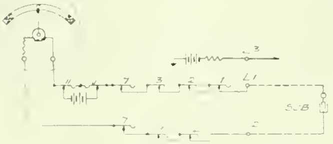


Fig. 25

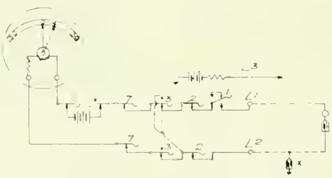


Fig. 26.

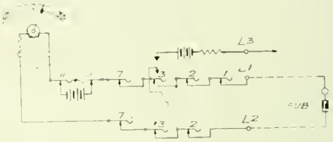


Fig. 27.

Testing L_2 for ground.

The next step is to test the sides of the line for cross or ground and to do this the "Test L_1" and "Test L_2" keys are alternately operated. Fig. 27 shows the results of operating key No. 1 "Test L_2" and also shows an imaginary ground on L_2 for the purpose of showing how the ground is discovered. On operating the key a deflection is immediately noted, and for present purposes this can be assumed to be due to a ground on L_2. Following the circuit on the figure the testing current can be considered as flowing from the negative pole of battery through the voltmeter, over L_2 to the ground at X, through the earth to the ground applied at key No. 1 and back to the positive pole of the battery and thus completing the circuit causing the voltmeter deflection noted. The deflection as noted in the figure is given as 15, which, if the voltmeter is 1000 ohms, would show that the ground also measures 1000 ohms. This, of course, includes part of L_2, and the resistance of the cross to ground itself. A method of determining these values has already been given, and it will be further dealt with in the section on trouble location.

Testing L_1 for ground.

To test L_1 for ground, key No. 2 is operated, and the same general results are obtained, but with a rearrangement of the test circuit by the operation of the key. Fig. 28 shows the circuit conditions when this key is operated, and shows how the circuit is reversed and grounded in one operation, thereby leaving the voltmeter and battery in same relative position to the line as before. The current path through the circuit, line and ground can be readily traced from the figure.

Testing L_2 for capacity.

Having now tested the sides of the line for leakage, and finding none, the grounds shown in the figure being for illustration only, we next proceed to test them for capacity, that is—in the case of local lines—to ascertain if there are any stations on the line with grounded bell circuits. This test is made in exactly the same way as a test for leakage, with the addition of operating the reverse key, as in the case of metallic capacity test, to produce a charge and discharge of any condensers that may be connected from L_2 to ground. Fig. 29 shows how this is done. The "Test L_2" key No. 1 is operated as in Fig. 27, and in addition the reverse key is shown with its full connections. It is obvious that a condenser at "X" will now be charged and discharged through the circuit thus set up, and the amount of capacity or number of condensers thus determined. Fig. 30 shows the same test for L_1 and the same conditions and results apply, with, of course, the different circuit caused by the operation of key No. 2 necessary for testing on L_1.

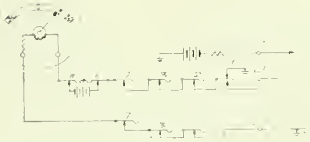


Fig. 28.

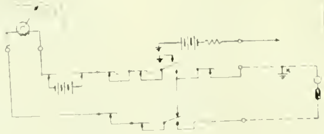
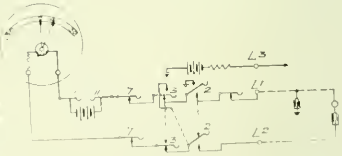


Fig. 29.



Fig, 30.

During any of these tests, except those for capacity, the tester can have his telephone connected at all times, for, referring to Fig. 24 the telephone is shown connected onto the voltmeter side of all testing keys, and, providing there is a condenser between it and the test circuit, no effect will be had on the tests from it, and it is very convenient to be able to listen on a line while testing, and thus be able to observe what would otherwise escape notice, such as intermittent induction troubles, etc. It is evident, however, that the tele-

(Concluded on page 42)

Electric Railways

More Car Barns For Vancouver

The British Columbia Electric Railway Company have recently placed in service at Vancouver a new car barn. At the present time the company have a barn in the centre of the city and another in the Mount Pleasant section. The new car barn is located in the western portion of the city, the company thus having barns distributed at several points, enabling them to economically arrange for the operation of early and late cars as well as quickly provide for special service in any section of the city. The new barn is 400 feet long by 52 feet wide and will accommodate 64 of the company's city cars.

In the construction of the car barn the entire site was excavated to a depth of 4 feet 8 inches below the street level. The excavation was then covered with a concrete floor 6 inches thick and concrete walls 9 inches thick were built up to the street level. The floor from each wall has a slope of one inch in six feet towards the centre line, thus providing good drainage. For one of the tracks a jackpit three feet deep and one foot wide extends under 200 feet of track, this being the only break in the concrete floor. Upon this concrete base, along the line of each track, 12 by 12 inch posts were placed at 8 foot centres. These posts supported 12 by 12 inch stringers upon which the rails are laid at the street level. In this way easy access is possible in all parts of the barn to the under side of the cars stowed therein. The subgrade was generally hardpan but in some places where the base material was not so good additional sills were placed under each of the 12 by 12 foot posts.

At the present time the walls above the street level are boarded with 2¾ inch shiplap on which is placed galvanized iron. This form of construction is followed as it is expected in the future to build other units, possibly all of reinforced concrete type, at the same place; the shiplap boarding will then be one side of the form for the reinforced concrete wall. The roof truss is of wood construction and is of simple type, the roof of the building being also of galvanized iron with wired glass skylights every 32 feet.

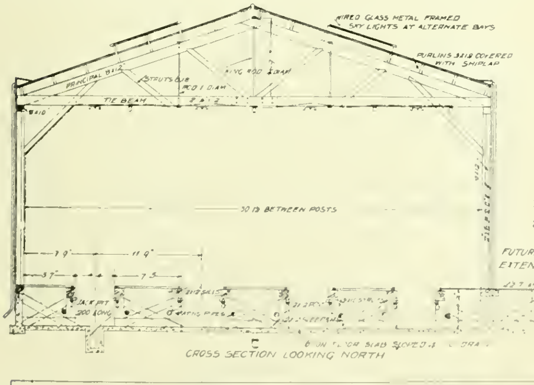
The building is generally lighted by 100 watt metal filament lamps so arranged as to provide one lamp to each 192 square feet of floor area. The timber construction, in the pit, supporting the rails is completely wired, sockets being placed here and there for use in repair work.

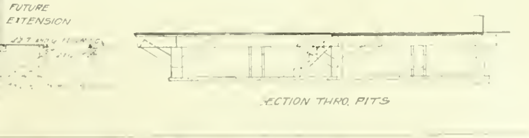
The building is equipped with a complete sprinkler system for fire protection as well as with five monitors mounted on towers just outside the building. These towers are about 20 feet high and support 6 inch stand pipes. The monitors have a range of 70 feet with a 2½ inch nozzle and the towers are placed 50 feet apart. The building is also equipped with a complete low pressure steam heating plant. The car barn was built according to the plans prepared by the company's architect and erected by day labor.

Electric Railway Statistics

A report of the Department of Railways and Canals regarding railway statistics of the Dominion of Canada for the year ending June 30, 1913, is just to hand. Some interesting data is given as to number of miles of track, stock capitalization, etc. The report places the total number of miles, computed as single track, of Canadian electric railways at 1,869.6 as compared with 1,723.51 the previous year, an addition of 146.12 miles during the year.

These figures scarcely do justice to the electric railway expansion in Canada during the past year as is shown by a comparison of these figures with those published in the February 1 issue of the Electrical News. As shown there, the total mileage in Canada is 2,080, an addition of 241 for the year. The discrepency is accounted for partly in that considerable activity was shown during the last half of the summer of 1913. However the government report has not taken cognizance of some 36 miles new road in Vancouver and Victoria, 20 miles in Edmonton and considerable extensions in Ottawa, Port Arthur, Regina and to the N. S. & T. lines as well as minor extensions by other systems. Neither does





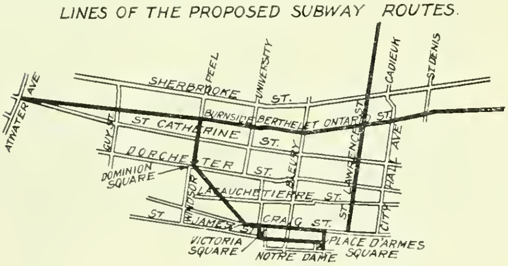
Sections and elevation of new car barn of B. C. E. R. Company, Vancouver

the government make any report on the Brandon Municipal System, the Edmonton Interurban Railway, the Saskatoon Municipal or Toronto Municipal systems.

Judging from all the figures the Electrical News has been able to obtain the year 1913 constituted a record in electric railway developments with the prospects for the coming year even brighter.

Montreal Underground

Mr. G. Janin, chief engineer, and Mr. McLeod, railway engineer, of the city of Montreal, have submitted to the Controllers a report on the transportation problems of the city. A short time ago the Montreal Tramways Company and the Canadian Autobus Company presented rival schemes for subways and autobuses to the Council, and these were referred to the city engineering department. The report is a very exhaustive one, and points out that traffic conditions have now reached such a stage that the providing of additional car tracks, the changing of routes, and increasing the number of cars will only secure temporary relief for a few months or a year or two, when the city will again be confronted with the problem of improving the service. The report, therefore, includes a series of recommendations for the construction of underground rapid transit lines, to be operated in conjunction with the surface cars, and the combination of these two to be supplemented by such motorbus service as may be deemed necessary; the widening of two or three streets to be used as business boulevards and afford



Proposed subway rates for Montreal.

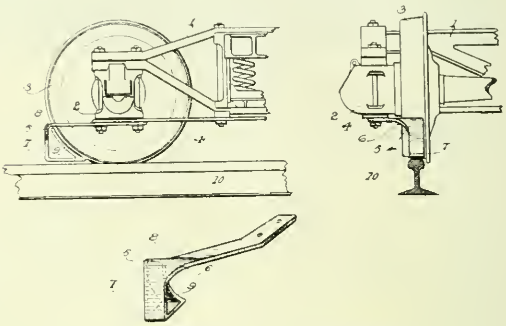
new arteries both for local car traffic and the increasing volume of vehicular traffic.

Owing to the extension of the city and suburbs, the rate of travel has since 1899 increased 310 per cent. or more than twice the rate of increase in population. The result is that there is an almost unbearable congestion of cars at the rush hours. The engineers discuss in detail various routes for subways, and recommend a subway running east and west from Frontenac street to Atwater avenue, via Ontario, Burnside and Luke streets, a distance of 3.45 miles, at an approximate cost of $8,800,000; a subway from Burnside street to Viger Square, via Craig and Latour streets, Dominion Square, and Peel street, 1.63 miles, approximate cost $4,800,000, to serve the down-town district; and a subway under St. Lawrence Boulevard, north and south, 3.45 miles, approximate cost $7,000,000. The total mileage is 8.21, and the estimated cost $20,000,000, exclusive of widening or extending streets and equipment and plant.

The engineers suggest that tunnels should be constructed under the Lachine Canal, and also that considerable changes in the routing of the existing surface lines will be necessary, in addition to the construction of new surface lines, especially in the outer wards of the city.

A Safety Wheel Guard

A new safety wheel guard is being tried out by Mr. M. O. Robinson, joint manager of the Fort William and Port Arthur street railway systems. The idea of the guard is to absolutely prevent any person or obstruction from getting under the wheels either from the front or from slipping in at the side of the car. The guard is hung from any convenient place either on the car truck or on the car body and goes down in front of the wheel clearing the rail by about



Showing design of new wheel guard.

one inch, then back to within ½ inch of the wheel, then up, taking the radius of the wheel to a sufficient height to insure protection. The design may be better understood from the accompanying sketches. In making this guard 2¼ in. and ½-in. iron bar is used. The device is the invention of Mr. A. A. Blennerhassett, of Fort William.

Ottawa Electric Railway Annual

The annual report of the Ottawa Electric Railway Company for the year ending December 31, 1913, showed that, for the first time in the history of the company, the gross revenue exceeded $1,000,000, amounting to $1,041,282. During the year operating expenses have been sixty per cent. of the gross revenue, a very satisfactory figure, which, indeed, has always been the case with this company, the percentages since 1900 varying between 57 and 66. The net earnings available for dividends were about 19½ per cent. A 12 per cent. dividend was paid with 3 per cent. bonus.

The report adds that the new work carried out and completed during the year was as follows:—1,000 h.p. sub-station on Centre street; 1,000 h.p. sub-station on Nelson street; extension of tracks to Ottawa south from Wilton Crescent, forming a loop on Sunnyside, Seneca and Glen Ave.; Preston street extension from Somerset street southerly and re-arrangement of tracks on Broad street; double tracks on Queen street from Bank to Elgin street; an additional track on Crichton street from Beechwood Avenue to Charles St. and a loop by way of John street; the 4,200 h.p. steam turbo-generator referred to in last annual report is expected to be ready for operation early in the spring; a large amount has been spent in improving the tracks and rolling stock as well as other properties, and the company is now in a better position than ever to handle any business that may offer.

Selkirk, Man.

The electric light rates of Selkirk have been reduced from 10c per kw.h. to 8c per kw.h., discounts remaining as before. The Selkirk electric system is managed municipally, power being purchased from the Winnipeg Electric Railway Company.

Railway Conditions Governing Electrification

By Roger T. Smith, M. I. E. E. *

Circumstances have decreed that up to the present time British electrical engineers have to go to the Continent or to America for examples of railway electrification for other than urban or suburban services. Now that the Institution proposes to have a series of papers on the subject of railway electrification it seems desirable to deal in the first of them with some of the railway conditions in this country which may account for our apparent lack of enterprise. Each country has its own railway conditions and economics, and because main-line electrification is economically sound or experimentally desirable in parts of Europe and the United States it does not follow that it may be equally right for us. The dearness of money and the demands of labor make it at the present time very difficult, if not impossible, for British railways to spend money in experiments on electrification other than on a small scale.

In a country like ours, possessed of a system of steam railways which have cost more to build than railways elsewhere, a third generation of men inheriting the traditions of the past is being trained to work them. It seems reasonable that if any change from steam to electricity is proposed by electrical engineers they should first endeavor to provide something which will at least do what steam will do, next try to give electrically what steam cannot give, and finally do this in such a way as will result in improved financial prosperity to the railway. It is far easier to change things than to change the habits and inherited instincts of large bodies of men, and electrical engineers have not only to show railway managers that they can haul the railway traffic either better or more cheaply than is done today by steam, but that they can first of haul traffic at least as well as it is hauled by steam, and fulfil most if not all of the functions of the steam locomotive in the manner in which those who work the traffic have been accustomed. Any proposal, otherwise economically correct, that will suddenly atter the way in which large bodies of men have been used to handle traffic in the past is not sound engineering or sound business unless the resulting gain is very considerable.

At the Paris meeting the Institution had the advantage of discussing not only certain applications of electric traction to French railways, but also a reasoned analysis on the position of electric traction on the railways of the United States as it appeared to a French engineer.

As an outcome of that discussion, and with the view of suggesting some of the things in railway working which steam now does, and are already done or will have to be done as well or better by electricity, it is convenient to divide railway service into three groups. These three groups correspond to entirely different conditions as far as traction is concerned.

1. Urban and suburban passenger services.
2. Fast passenger services.
3. Fast or slow goods and mineral service.

It is not pretended that this exhausts the types of services for which it is profitable to consider electric as compared with steam haulage. For instance, the electrification of terminals is not included, nor incline working, nor the marshalling of passenger and goods trains, nor the working of goods and mineral shunting yards. Shunting conditions only will be referred to later. The above division is sufficient, however, for the purpose of such generalization as is alone attempted in this paper.

*Part of paper presented before the Institution of Electrical Engineers.

1. Urban and Suburban Passenger Service

Urban passenger service.—A purely urban electric service is a thing so much apart, and has been so excellently engineered as far as London is concerned in its underground railways, that it is not necessary to discuss it in any detail here, since it differs only in degree from suburban service. Steam traction for underground services is out of the question in the twentieth century; quite apart from any special advantage that electric traction may possess over steam traction in the matter of services with frequent stops averaging about half a mile apart. All underground passenger haulage must be electric.

Suburban passenger service.—A suburban passenger service exists to enable a working and business population to live outside the town in which it works. In this country suburban transport has mostly grown haphazard with the population and its extent is governed by the time which people consent to spend in the train between their homes and their business occupation. Excluding outer suburban service the limit may be taken to be about 45 minutes each way. The greater the distance covered in that time, that is to say, the higher the schedule speed(average speed including stops) of the train the more chance has the railway of creating new traffic.

If a railway possessing a suburban system equipped with permanent way, platform accommodation, and locomotives designed for a certain time-table finds this equipment outgrown by the traffic, it is obvious that it must increase the number of coaches run in a given time. To do this several courses are open.

First, it may double or treble the number of tracks and increase both the number and length of its platforms, thus increasing the number of passengers carried without necessarily increasing the journey schedule time. In the past this has been done on several of the London railways with suburban services, the cost of widening the line and rebuilding the stations having been enormous.

Secondly, the railway may retain its permanent way and stations and with them the maximum length of its trains, but increase their schedule speed by using the biggest type of steam locomotive permitted by the load gauge for running comparatively light suburban trains. This has been worked out and tried experimentally for the Berlin suburban service, but comparatively little has been done by locomotive engineers in this country to design a steam locomotive purely from the point of view of the rapid acceleration of a light suburban train. It has been done on the Great Western Railway and also in the case of the rail steam auto-car, which, with high adhesive weight, does possess fairly rapid acceleration.

Thirdly, the railway may electrify, which solution is commending itself to many of the railways in this country with congested suburban services. With electrification a maximum of 48 trains an hour can if required be run each way during the rush hours while employing existing stations and tracks. That it is possible to run trains so close to each other is chiefly due to signalling by track circuits, but full advantage of the possibilities of running up to 40 or more trains per hour by the use of track-circuit signalling can only be taken by trains having rapid acceleration and very rapid deceleration. With tracks and stations (and hence also the

train length) remaining as before, the number of passengers carried per hour has in many cases been doubled by increasing the schedule speed fifty per cent., while improved signalling has at the same time made it possible to increase by fifty per cent. the maximum number of trains per hour.

The characteristics of urban and suburban services for which electric traction is suitable are a dense or fairly dense service of not less than, say, five trains per hour each way, up to forty and more per hour each way, with station stops varying from less than half a mile apart up to 1½ miles apart. With services less dense than the minimum, and with stops further apart on the average than the maximum here given, the advantages of electric traction, if they exist, are special and not characteristic.

The essential element which gives to electric traction its advantage over steam under these conditions is the motor-coach train. The train is made up either entirely of motor coaches (as in the western suburban system of the French State Railways) or of motor coaches and trailers. The number of motor coaches must be such that the weight on the driving wheels available for adhesion is not less than 25 per cent. of the total train weight. It is more often 33 per cent., and may be 100 per cent. The making up and driving of such trains has been rendered possible by multiple-unit control.

With the motor-coach train it is quite easy to have such an adhesive weight as will permit of a tractive effort, over and above that required to haul the train against resistances, sufficient to accelerate it during the notching period at rates up to 1½ miles per hour per second (2.2 ft. per second per second), while the rate of deceleration is usually increased up to 2 miles per hour per second. Such a rate of acceleration is not often justified, and a more characteristic example may be taken from one of the London suburban services where trains weighing 175 tons are accelerated during the notching period at 1.7 ft. per second per second to give with 20-second stops a schedule speed of 17 miles per hour, the station stops averaging half a mile apart. The adhesive weight is 46 per cent. of the train weight, and the energy input while accelerating is 1,300 h.p. Within the load gauge of this railway no steam locomotive could be built of such a power. If it could be built it would have (in order to give the necessary adhesion and power) four times the weight of the electrical equipment, which is distributed over eight axles.

The Multi-unit train

Other advantages of the multiple-unit-controlled motor-coach train, as has often been stated, are first the doubling of terminal accommodation by halving the number of signal and locomotive movements, and secondly the ability to make and break up the motor-car and trailer units of which the maximum train is composed to suit the traffic.

No piece of apparatus is more fitted to accelerate a train rapidly than an electric motor with a series characteristic. The series-parallel connection of the continuous-current motor can give without opening the circuit two running speeds for each definite load after acceleration is complete, while in the single-phase motor voltage regulation can give as many running speeds as are desired.

For any suburban service requiring 20 trains per hour to bring morning passengers in and take evening passengers out of a city, tracks and terminal accommodation must be set apart exclusively for the purpose. It is not overlooked that two of the most important and successful suburban electric services of the Lancashire and Yorkshire Railway and the Newcastle suburban service (if such it may be called) of the North-Eastern Railway, run for some distance over main lines used by steam trains. The maximum number of trains per hour is 12 each way in the case of the Lancashire and Yorkshire service, and 6 each way in the case of the North-Eastern service. The North-Eastern electrification is something more than a suburban system, while the Liverpool-Southport service is a very successful experiment in the creation of new traffic, which makes it typical of the best sort of suburban service.

In general, however, it is safe to say that until it is necessary to devote terminal facilities, station accommodation, and at least two tracks entirely to a suburban service, it is very doubtful if electrification is the only solution of the congested traffic problem, although it may prove to be the best solution. Most of the suburban services into and out of London already electrified or in process of being electrified are run on tracks distinct from the main line, and such a service becomes a thing apart. It can be electrified on any system which best suits its conditions, and the method may be quite different from any other method which may subsequently be desired for main-line electrification.

Under such conditions—and they are exemplified on the largest scale in Europe by the suburban lines leaving the St. Lazare Paris terminus of the Western French State Railway system—the results of suburban electrification all the world over show that there are really no fresh engineering problems to be solved. On both sides of the Atlantic there are numerous examples all more or less on the same lines, two new systems out of London, one north and the other south of the Thames, being now in process of equipment by the London and North-Western Railway and the London and South-Western Railway respectively. Compared with steam haulage the measurements of power are so simple and cheap that when the traffic department asks for any reasonable schedule the engineer is not only able to design his equipment to work to it, but can within very close limits what it will cost in power and what it will cost in maintenance.

The Financial Side

Passing from the engineering to the economic side, the question of the electrification of a suburban system has become for a railway company purely one of finance. Essentially it resolves itself into a question as to whether the fares charged for the service, even with the additional traffic obtained, can give a reasonable return, or any return at all, upon the new and old capital, after the cost of working has been provided for.

When electric tramways were developed in this country for urban and suburban services they competed directly with railway steam services in many large towns. As an example, when London started its electric tramway service on the south side of the river the suburban steam service of the Brighton Railway decreased from eight million passengers to five million passengers per annum. On electrifying its lines not only did the railway regain this loss in the first year but it has since added to its traffic steadily; at fares, however, lowered by the tramway competition.

It must be remembered that the tramway uses the streets and pays only for its construction, for part of the paving, and for a part or the whole of necessary street widenings. The railway has paid for the land—often acquired compulsorily at an exorbitant price—and has had to put on the land costly permanent way and structures. Usually a railway company is the largest ratepayer in any parish through which it passes, and is often the largest ratepayer in any town. It may therefore be called upon to pay rates to a municipal body on which it is not represented, in order to keep up part of the roads used by a competing tramway. If the municipal tramway is run at a loss the railway helps to pay the losses of a competitor whose presence reduces the railway fares.

The tramway in turn is now menaced by the competition of the motor omnibus, which pays nothing beyond the patrol

tax for its right to use the roads in order to compete with both railway and tramway.

The management of a railway has to decide in each individual case whether, considering its handicaps in the cost of its road, which one of its competitors has not to meet at all, and its high rating, which may go to assist the other competitor, it can make enough money out of competitive fares to justify the added cost of electrification.

Even when it cannot make the development of its suburban traffic pay directly it may still pay the railway as a whole considered only as a feeder to the main line, or urban and suburban traffic as a whole may pay if the latter goes far enough out into the country. This latter type of suburban service is best illustrated by the Liverpool-Southport electrified system on the Lancashire and Yorkshire Railway.

From Liverpool to Hall-road, 7⅞ miles away, the average distance between stops is ⅞ mile and the schedule speed is above 25 miles per hour. This is probably the most rapid suburban service in existence. From Liverpool to Southport is 18½ miles, with an average distance between stops of 1 1/3 miles, but beyond Hall-road this average is only a little under 2 miles. The schedule speed of stopping trains is 30 miles per hour. The maximum instantaneous input to the train is nearly 2,000 h.p., and the power consumption for the stopping trains to Hall-road is about three times the power averaged over the whole service of stopping and express trains and idle mileage. This is an excellent example of how a service if extended far enough out and combining express with stopping trains reduces the energy used over the whole system to a reasonable figure. The long-distance fares have to make up for the far greater cost of the short-distance stopping service.

Not only have electrical engineers completely solved the engineering problem of frequent service with short distances between stops, but the cheap and simple measurements of electrical quantities have taught railway companies for the first time how costly the constant stopping and starting of a train must be as compared with running at high speeds with infrequent stops, whatever form of power is used for traction.

It is not that suburban electric traction costs an unreasonable amount, but that circumstances make the revenue from such service unremunerative. Suburban fares have been falling steadily, and at the present moment it is safe to say that everybody in London and its suburbs is being carried at too low a fare to give proper remuneration to any form of traction which, in addition to rates and taxes and government duty on some fares, pays for its road and the right to use it.

From the report of the London Traffic Branch of the Board of Trade for 1912, particulars of London urban and suburban traffic can be obtained and compared with the returns and estimates of the omnibus and tramway traffic. From these returns it appears that if the suburban systems of the main-line railways running into London are left out of account there has on the whole been no increase during the last three years in the number of passengers carried by the underground railways of London, all of which are electric. Quite considerable increases have taken place in some lines—the District carried 7¼ per cent. more passengers in 1912 than in the previous year—but other lines lost some of their passenger traffic, and the total number remains stationary at about 436,000,000 passengers per annum. The average fare was a trifle above 1½d. The purely London traffic of the main-line railways—inclusive of their suburban traffic—is estimated for 1912 as 250,000,000, which is a decrease of 1¾ per cent. on the traffic of the previous year.

The London tramway traffic in 1912 is estimated at 800,000,000, which is a decrease of 3 per cent. on that of the previous year, while the omnibus traffic amounted to 550,000,000, or an increase of 37 per cent. on the 1911 figures. Greater London traffic as a whole increased by 125,000,000 passengers in the same period, which is 20 per cent. less than the omnibus increase, every other form of traffic having declined except that on the underground railways, which remained stationary.

A Parliamentary Committee has been investigating the problem of the city, circular, and suburban services in Berlin, and it reported at the end of 1912. Fares have been reduced to such an extent that in that year they averaged ¾d. per passenger, or half the average unremunerative fare in London. With steam traction these fares do not pay working expenses, and no capital charges whatever have been paid of late years on about £12,000,000 spent on the Berlin railways.

In 1913 money was voted for the electrification of the city and circular railways, but the suburban electrification is not to be dealt with at present. The point of interest is that, after electrification, fares all round are going to be raised to such a figure as will not only pay working expenses but capital charges (interest and amortization) on the old and new capital.

Like most other industrial working costs, that of running a suburban service depends on certain standing charges which taken as a whole do not vary, or hardly vary, with the service given (upkeep of permanent-way equipment, management, rent, rates and taxes, and station traffic expenses) and a charge varying with the service catered for (rolling-stock, repairs and wages, running wages and electricity). In a particular case the ratio of standing to variable charges for running a small suburban service for a year was as follows: Standing charges unaffected by the number of trains 60 per cent., variable charges 40 per cent., and of this 40 per cent. electricity formed three-fourths.

If the cost of electricity can be reduced by fifty per cent. the total working costs may be reduced by one-quarter, which shows the importance of cheap electricity. This is a particular case where the cost of electricity was high, and as a rule its percentage effect is not so great.

What is wanted to make urban traffic on electrical lines pay is either an increase in the fares, which is achieved abroad by zone fares, or the ability to purchase electrical energy delivered to the conductors at say ¼d. per kilowatt-hour. Competition may prevent the former. Is there any chance of obtaining cheaper electricity?

The Supply of Electric Energy

The generation of electrical energy and its supply is a business in itself. In many cases it has not in the past been possible for railways electrifying suburban services to buy electricity from outside, but wherever they have been able to do so the saving of the initial cost on which capital charges have to be met and the saving to the railway of the management of a business organization that is very different from its other organizations is a great gain. In general, the addition of a load which in the case of a heavy suburban service may continue during 18 or 20 hours out of the 24 with an annual maximum demand load factor of from 45 to 55 per cent., should enable a supply authority with a light and power load to offer a railway company such a price as would leave no question as to its acceptance. It is scarcely necessary to point out, however, that the purchase of electrical energy has not been the policy of the majority of the railway companies. Some of them have had no chance of buying, but those like the North-Eastern and London, Brighton and South Coast Railways who have purchased electrical energy have no reason to regret it.

To sum up the situation with regard to suburban electrification as it appears to the author, the electrical engineer is in a position to inform his railway very exactly what the

initial and working cost will be. The management have to decide what the financial result will be with the existing and expected traffic, which has to pay working and capital charges on the new capital before earning a dividend on the old. Competitive fares are so low that the process is generally discouraging except where a new traffic can be created in districts from 10 to 30 miles from the terminus. The cost of electric working is important, but as Mr. Insull has recently pointed out the cost of money may be still more important, and the raising of fresh capital for anything that is not certain to swell the dividend is a very serious matter indeed at the present time when the credit of British railways stands so low.

2. Fast Passenger Service

When the condition of frequent stops and short distances between them is left and the question of main-line passenger services as run by steam locomotives is considered from the point of view of electric traction, the problem alters completely.

To give some idea of the effect of stops it may be mentioned that in a particular steam service a 7-coach train weighing 187 tons, including a dynamometer car, required an average draw-bar horse-power of 277 when hauled by a steam locomotive at an average schedule speed, including stops, of 40 miles per hour, the stops on a nearly level road being 23½ miles apart. The same train, run at an average schedule speed of 27 miles per hour and stopping on the average every 5½ miles, required an average draw-bar horse-power of 284, or practically the same. The time taken to do the same distance is in the ratio of 1 to 1½, so that the energy used for the stopping service for the same distance is 50 per cent. greater than for the fast service. The condition of the track, wind, and weather make such great differences in the power, than any generalization from individual tests is dangerous, and such tests are too costly to be made often; but such an instance will serve to indicate how increasing fourfold the number of stops in a given distance makes the cost of hauling a slow train much greater than the cost of a moderately fast service with few stops.

A good deal of experimental and pioneer work has been done on the Continent and in the United States in electric locomotive design, but the engineering problems which have to be solved in this country before fast passenger electric services can compete with existing services have hardly been considered.

In a paper such as this, only intended as a preface to more detailed papers and to stimulate discussion, it is impossible to do more than touch in general terms on some of the difficulties.

The steam locomotive is so designed that with earlier and earlier cut-off as the speed increases, practically constant outputs are obtained for the same load. The time tables of British railways imply maximum speeds of between 70 and 80 miles per hour. The resistances to train movement increase in proportion to the speed raised to the 5/3 power, so that for trains running with infrequent stops a locomotive with constant output has sufficient reserve of power at low speeds, over and above that required to overcome resistances, to give a moderate acceleration (up to the limit imposed by the adhesion of the coupled wheels) and to maintain the train at any speed (determined by the regulator and the cut off) up to the maximum speed with that load.

As compared with the electric locomotive the steam locomotive is handicapped by the distribution of weight due to the length of the boiler. In the former, from the shape and size of the motors it is possible to get a greater ratio of adhesive to total weight than in the latter, especially if every axle is driven. In general for fast passenger service the acceleration of the steam locomotive is limited not only by the boiler capacity but by the maximum adhesive weight on the coupled driving wheels.

For the 4—6—0* type locomotive, the adhesive weight being absolutely limited by structures to 60 tons, and by usual practice to 56 tons, the starting draw-bar effort is limited to about 16 tons. From the start until the driving wheels are moving at about 50 revolutions per minute—say about 12 miles per hour for the engine under discussion—the maximum draw-bar pull is 12 tons, determined by the adhesion.

Such a passenger engine can haul a train of 450 tons on the level at the highest speeds called for in this country and, unassisted a train of 300 tons up a gradient of 1 in 50. The maximum length of the train is in general limited by the minimum length of the station platforms, and without radical changes in station structures no heavier trains can be run except for occasional "rush" traffic. To haul such a train, a constant-output locomotive is satisfactory, and the control of the output and speed by the regulator and the cut-off is so complete that the steam locomotive can run at any speed below its upper limit for the load hauled.

With the exception of certain three-phase locomotives in Italy and America, all the electric locomotives built have been equipped with motors having series characteristics. At any given voltage the series motor has one speed for each definite load. Series-parallel control with continuous-current motors gives two speeds, and with certain numbers of motors three speeds for continuous working can be obtained.

The problem of getting the adhesion necessary to prevent the slipping of the wheels when starting is, in general, possible with appreciably lower axle loads than for the steam locomotive, while for the same tractive effort the advantage in total weight is always in favor of the electric locomotive. Since the series motor can be overloaded momentarily 75 per cent. above its hourly rated capacity, while for adhesion purposes if necessary every axle can be made a driving axle, very great starting torques are possible, but on British railways they would be not only useless but actually harmful, exceeding the draw-gear strength. Unlike the case of the multiple-unit train, the adhesive weight may be only 12 or 14 per cent. of the total train weight, and the strength of the draw-gear limits the draw-bar pull after starting to 12 tons. But with an increase in speed the torque of the series motor falls off so rapidly that above 60 miles per hour (where difficulties begin with steam locomotive design) no electric locomotive yet built for hauling only such maximum loads as obtain on our railways could give anything like 1,100 h.p. at 70 miles per hour.

The Economic Side

One object of the series winding is to saturate the field of the electric motor at starting, and provided the field is saturated no extra current through the winding is of any use. The field can equally well be saturated by separate excitation, which opens out the possibility of a shunt characteristic with variable speed for the continuous-current motor, voltage variation already providing several running speeds with the single-phase motor.

The very interesting experimental line equipped by the Lancashire and Yorkshire Railway for 3,500-volt continuous-current electrical working between Bury and Holcombe Bridge has two motors on its motor coaches permanently in series and a motor-generator for providing current at 100 volts for the auxiliary service of control, brake pump,

* There is no uniformity in different countries in the symbols used for types of locomotives. This paper follows American and British steam practice, thus 4—6—0 indicating a leading 4-wheeled bogie, 6 coupled driving wheels and no trailing pony or bogie. 2—8—0 indicates a 2-wheeled leading pony, 8 coupled driving wheels and no trailing pony or bogie. 4—4 + 4—0 indicates an articulated locomotive with leading and trailing bogies and 4 driving wheels in each half.

lighting, and heating. The same principle could be used for exciting the field, and it is suggested that such a method of obtaining the series characteristic at starting and the shunt characteristic for higher speeds is worthy of consideration.

Turning from the engineering to the economic side, and assuming a suitable electric locomotive has been built, a very rough estimate may be made of the cost of working, more with the purpose of showing the direction in which economies are desirable than of giving any figure that can be used for estimating purposes.

The annual cost of a steam passenger locomotive, averaged over all the different types in use on a railway carrying passengers, goods, and minerals over not less than 2,000 miles of route, and hauling its own locomotive coal, may be taken to be £825 for such items as do not vary with the mileage run or only vary to an extent which will not affect this first approximation. These include capital charges (which are taken at 6 per cent. for interest and obsolescence), administration and management, wages of drivers and firemen, oil and small stores, maintenance repairs and renewals. To this is to be added the cost of coal and water, varying more or less directly with the mileage, which for passenger service may be conveniently taken as the train mileage. The annual cost of coal at about 9s per ton per 10,000 B.t.u. averaged over the whole working together with the cost of water may be taken to be £350, giving a total for the year of £1,175 inclusive of capital charges. This is a mean for all locomotive types working an average passenger mileage of 10,000,000 train-miles per 1,000 miles of route. During the year a passenger engine may be expected to run between 25,000 and 30,000 or say 27,000 passenger train-miles, so that the mean cost for locomotive expenses (including locomotive capital charges) per train-mile will be 10½d.

Of the above sum of 10½d. per train-mile 3d per train-mile will represent the cost of coal and water. After the coal strike in 1912 the cost per ton went up 2s., but neglecting its present high but fluctuating value, and taking the cost of the best English coal used at 12s 6d per ton, to which 3d per train-mile corresponds, cheap coal in this country is one of the factors making against railway electrification. The cost of coal burnt in a large modern generating station producing electricity for hauling trains by an electric locomotive is less than half the cost of coal for doing the same work in a steam locomotive. In America coal costs about the same as in England, but in France the 3d per train-mile for coal and water would be at least 6d, and in Switzerland and Italy 9d or more. The influence of the cost of steam locomotive coal in non-coal-producing countries, more especially where water power is available for generating electricity, becomes obvious from this form of analysis without claiming any great exactitude for the actual figures given.

In the paper on 2,400-volt electrification already referred to, Mr. Hobart works out the efficiency of a Pacific type 4—6—2 steam locomotive between the heat value in the coal in the tender and the work done at the draw-bar, and correcting his constants for the results obtained with the largest modern English locomotives using coal of a calorific value of about 15,000 B.t.u. per lb., the value of this efficiency is 3¼ per cent. Allowance is made in this figure for the coal used in firing up and remaining in the firebox at the end of the journey. He also quotes the actual efficiencies obtained between the heat value in the coal in the bunkers of a large modern electric generating station using similar coal and the work done at the drawbar of an electric locomotive for similar work, and finds it to be 6 per cent. after his constants have been altered to suit English conditions. Working from these efficiencies the result is obtained that the cost of electricity per passenger train-mile is about the same as the cost of coal and water per passenger train-mile hauled by the steam locomotive, provided that electricity can be bought at 1/3d per kilowatt-hour.

Weight for weight the electric locomotive costs about twice as much as the steam locomotive, but for the same adhesive weight the electric locomotive weighs some 30 to 40 per cent. less than the steam locomotive. Electric repairs and renewals cost less, and the net result is that the annual cost of the electric locomotive will be in the neighborhood of £1,250 per annum, assuming the same rate for capital charges.

But while the passenger steam locomotive only runs on the average 27,000 train-miles in the year, spending 75 per cent. of the time out of active service, the electric locomotive, which need only be in the shops for one month out of the twelve, will not spend more than fifty per cent. of its time out of active service. The electric locomotive can run at least 40,000 passenger train-miles per annum. There is not much experience to go on, and that experience has been wholly obtained in other countries. The suburban working in London where electric locomotives are used is so restricted that no figures are obtainable which can be compared with steam working. Multiple-unit motor-cars run 45,000 to 50,000 miles per annum.

If these figures are accepted, the cost per train-mile with the electric locomotive (including locomotive capital charges) will be 7½d, always assuming that electrical energy can be bought at 1/3d per kilowatt-hour.

Only an Approximation

It must again be emphasized that these figures can only be considered as a first approximation to the truth, and they will differ for different railways. But assuming that for a railway running 10,000,000 passenger train-miles per 1,000 miles of route, the conditions enabled electric locomotives to run 40,000 miles annually, so that a saving of 3d per train-mile was secured by electrification, there would be a possible annual saving due to electrical working of £125,000. If capital charges (interest and amortization) were 6 per cent., this would represent the charges on a capital of £2,100,000 per 1,000 miles of route, or £2,100 per mile of route. This sum would certainly not cover the corresponding electrical equipment of the line on an overhead system, inclusive of contact wire and structures, distributing cables, bonding, and sub-stations.

The only items for which a reduction in costs may be expected are the cost of electricity and the capital cost of electric locomotives. No great reduction in the cost of the former can be expected so long as railways generate their own electrical energy, as there must be a diversity of load and generation on a scale far beyond railway requirements to secure an appreciable reduction in price. If electrical energy could be bought at ¼d per kilowatt hour, and the electric locomotive could be made for £50 per ton, the cost per train-mile in the above estimate would be reduced to about 6d.

The problems in front of the electrical engineer who would compete with the passenger steam locomotive are therefore first to design an electric locomotive that will do what the steam locomotive does at high speeds; secondly, to reduce the cost of the electric locomotive (which will come about when there is sufficient demand for it); and thirdly, to be in a position to buy electrical energy at something approaching the ⅛d per kilowatt hour which forms Dr. Ferranti's ideal.

Contract has been awarded by the Winnipeg Board of Control for tower footings along their new transmission line between Winnipeg and Point du Bois.

The Dealer and Contractor

The Old and the New Code

At a recent luncheon of Toronto "Jovians," Mr. H. F. Strickland, chief electrical inspector of the Hydro-electric Power Commission, gave a talk on "The Old and the New Code." Mr. Strickland spoke as follows:—

In a limited time it is impossible to go thoroughly into all the details of such an extensive question as electrical inspection of a province the size of Ontario. I will, therefore, confine my remarks to a short, comprehensive outline of the plan of inspection and the probable method of enforcing it.

We all know that it is necessary to first of all formulate proper laws and such as can be regarded by those who know as just and practical. Then when the law is passed it is of little or no use unless it is enforced. In the case of the old inspection there is not very much the matter with the rules or what we might term the old law. The chief weakness with these old rules is the fact that they do not specifically cover the life hazard. The old rules were made almost entirely under the supervision of the Fire Underwriters and kindred associations whose one interest is the prevention of loss from fire, and I think that we can all safely say that the little National Code has been a familiar figure in the electrical world over this entire continent and is a by-word amongst the electrical fraternity, and that there was little wanting in it so far as was required to get a pretty satisfactory job if carried out to the letter. So much for the departed friend. We always like to speak well of those who have gone before, and I think I am not going too far when I say that the book of regulations now produced by the Hydro-electric Power Commission will be the recognized standard of electrical installation work in this province for a good many years to come, with, of course, such amendments and additions as may be necessary from time to time owing to fluctuations in the conditions. At this point it would be well to remark that the National Code when it first appeared was not anything like it is at the present time. The Hydro-electric Power Commission's Rules as they stand to-day have adopted a good deal of the matter originally in the National Code, for the simple reason that after having made a most exhaustive inquiry the Commission decided that there was nothing that would suit local conditions better than the main substance of this little code. The text of the code was carefully read through and re-edited, making considerable change in the phraseology of certain rules, eliminating a great many repetitions, adding a number of other rules and deleting a few unnecessary ones, and finally the whole substance of the book was re-classified and put in much simpler and practical order.

The national code was written in the form of a suggestion throughout, owing to the fact that the Fire Underwriters have had no legal power of enforcing their requirements other than by an increase of insurance rates which often were detrimental to the interest of the companies bidding for insurance business.

As the Hydro Power Commission's Rules were to become a law in the province it was necessary that the book be re-edited in such a way as to make all requirements positive, clear and concise, which I think is conceded by most people who have studied it carefully to be the case. The question of enforcement is now the next problem to deal with. The law requires that municipalities must appoint electrical inspectors and also has invested the Commission with power to approve of the selection which any municipality may make. I am not at the present time at liberty to make any statements as to what the Commission may do or what further legislation they may ask for, but I have reason to believe that as time goes on they will continue to receive the necessary amendments to the Act to obtain the best results. In the meantime the municipalities have been notified throughout this province that they are expected to pass the by-law giving their municipality the power to regulate electric wiring and the use of electric current within their boundaries. The commission have prepared a uniform by-law which has been printed and is sent to all the different municipalities, which they must copy and pass, thereby relieving them of much loss of time, expense and worry in drawing up a varied assortment of by-laws throughout the province, some of which might be useful and others perhaps useless. The form of by-law which has been prepared by the Commission is printed on the back of the Rules and Regulations, and covers all the points which are liable to present themselves, for the present at least. The commission have power to amend this by-law, add to it or change it as they may in their wisdom consider advisable.

Much has been done

In a great many of the important cities in Ontario the by-law has already been passed and electrical inspectors appointed and results are already forthcoming, so that it is likely before the end of the year there will be in the neighborhood of one hundred municipalities from Ottawa to Fort William carrying on a municipal system of electrical inspection. The work of the different inspectors throughout the province is subject to the supervision of the Hydro-electric Power Commission, that part of the work directly connected with electrical inspection being handled by what is known as the Rules and Regulations Department, which at the present time is in charge of the speaker, but like all other departments in the commission is subject to the authority of the chief engineer of the Hydro-electric Power Commission, so that what limited knowledge I may have of the work generally is further enhanced by the engineering experience and advice of the chief engineer. The result of this system should ultimately be very satisfactory to all parties concerned, inasmuch as the system of inspection, the enforcement of rules, the general interpretation thereof and the final settlement of all disputes will be uniform, as they must ultimately revert to the Hydro-electric Power Commission for adjustment. One of the chief difficulties experienced in the country to the south of us is that while they have many civic inspection bureaus the interpretation and enforcement of the rules is largely affected by the personnel or idiosyncracies of the inspector, resulting often in con-

fusion and a duplication of devices to suit the whims and peculiarities of any particular inspector who may fancy that he is divinely inspired to enforce the rules just a little better than somebody else. However, your chief inspector does not make any claim to any superior inspiration, but will carry out the orders of his employers to the effect that the rules be enforced in their full broad meaning, that everybody get an absolutely fair and unprejudiced decision and that cheap substitutes for approved material and workmanship be not tolerated, and so long as I have the honour to serve the commission I will take great pleasure in endeavoring to carry out this policy to the best of my ability.

In a word, the entire system of inspection is under the control of one final authority, namely, the Hydro-electric Power Commission, resulting in a uniform and legal administration of electrical inspection laws. Now, in anticipation, this condition is ideal, and I hope before long that the realization of it will be all that can be expected. We all appreciate the difficulties which confront the electrical contracting interests, such as, that people who are endeavoring to carry on a first-class business and handle only approved material are confronted with competition from irresponsible amateurs who, under the present dispensation, are able to do anything they like. This fact is well known to all people engaged in the electrical fraternity, both to the contractor and jobber without any further elaboration. Already old code rubber covered wire is becoming a drug on the market, and in several municipalities connection has already been refused by local inspectors, to installations where old code wire had been used. This may seem a trifle hard at first, but the contractors had been fairly warned that new code wire only would be accepted, and if they choose to play with fire they will get their fingers burned.

The Life Hazard

The new regulations of the Power Commission, in addition to the rules pertaining to the fire hazard, contains also sufficient extra safeguards to prevent, as far as reasonable, electric shocks or danger to the unskilled person who is inadvertently brought in contact with electrical apparatus or fittings, voluminous productions have been produced and many hours of thought expended on fuses, and the fusing of circuits, so that they cannot be improperly or over fused. The result of all this deliberation has been the production of cartridge fuses with different types of alteration, with the object of making them non-interchangeable, but, all said and done, there is no rule heretofore to prevent anyone from fusing up his main cut-outs with gas pipe or over-fusing it beyond the melting point of the wires they are pretending to protect. Under the Hydro-electric Commission regulations all main fuses must be enclosed in a sealed up metal enclosure and proper warning placed on the box that if these main fuses are tampered with or the seal broken the offending parties will be liable to prosecution. I think I am pretty safe in saying they will be prosecuted. This at least insures that the installation will be protected so far as the main fuses are concerned, and if amateurs or others choose to over-fuse their branch circuits they can only go so far and no farther. There is nothing in the rules to prevent the consumer from having an auxiliary main fuse if he desires it, but he will soon learn to know that once he goes past the safety point he will blow his main fuses, and it will likely cost him something to have it replaced.

There is one point in connection with the whole of the electrical inspection methods which is of the utmost importance and one which I wish at this juncture to emphasize very strongly. That is, the prevailing notion amongst a great many electrical contractors and also an impression which a great many of these people give their customers, that the new regulations will greatly increase the cost of electric wiring. I wish to bring out this point very strongly, because it is one of great importance to central station operators, both municipal and private. In answer to this I would quote the statement of one of our best known electrical central station operators in Canada, who in writing to us recently used the remark that even should proper regulations somewhat increase the cost of electric wiring I am firmly of the opinion that it should be safe at any cost. When this statement is thoroughly digested the force of it becomes more and more apparent. When one is called upon to enter the home of some unfortunate family whose husband and father has been suddenly carried out from their very midst in the prime of life through an unfortunate accident owing to defective electrical installation, the truth of this statement is brought home in a most forcible and grevious manner. I have now been in three homes during the past twelve months where just such an accident has occurred, and in each case the electric wiring was defective and could have been originally installed for practically nothing more in the way of expense than was expended in doing work in the way in which I found it. The cost of plumbing was at one time considerably less than it is now, but who amongst you would be willing to return to the old system of plumbing with its absence of proper vents, syphons and traps that was so common before disease and death was the means of bringing about better and more sanitary arrangements.

The object of the wiring rules and regulations is to ensure to the unskilled and untrained people of the community a reasonable protection against shock and fire, and again, to encourage skilled and bona fide electrical workers that when they give an estimate on doing work in accordance with the specifications laid down in the Hydro Rules and Regulations that their trade will not be interfered with by the work of unskilled people who in the absence of any proper system of inspection are at liberty to do pretty much as they like. I want to say also at this juncture that wiring contractors who make the cry to their customers that the wiring regulations are greatly increasing the cost of wiring are only admitting that they have heretofore been giving their customers small measure for value received. To prove this statement it is only necessary to mention that there is little or nothing in our regulations requiring any greater expenditure of time and material than was originally suggested in the rules of the National Code. The chief difficulty is that in one case our regulations will require that the work be done in accordance with the letter, whereas in the past there has been no way of enforcing the requirements except in a few centres where there was inspection by the Fire Underwriters.

Extra Cost is Small

As a further illustration of this argument we will take the case of a moderate sized home, say a ten roomed house. To wire a house of this size with knob and tube wiring with an ordinary outfit of switches and the number of outlets which would be ordinarily found in a moderate sized home would cost between $60 and $85, varying somewhat according to whether the switches were flush or surface, but taking $75 as a fair price it will just cost about 75c more to do this job in accordance with our Rules and Regulations as against the National Code requirements. Now, gentlemen, I ask whether 75c or even $1.75 is a serious matter when the safety of your family is at stake. Is there any man who would grudge 75c to save his wife from shock, fire or possible injury? yet, in the face of these facts we have already had some contractors, where electrical inspection is being rigidly enforced, raising the cry that it is greatly increasing the cost of wiring, their chief object seemingly being to make the system of inspection unpopular and to get back at the inspector.

There is an element of inconsistency through all this.

On every hand the cry goes up among the electrical contractors for good inspection. I therefore say to all those engaged in the business, chiefly in the outlying towns, now that we are giving you this inspection do not encourage such talk but make the municipal councils of your municipalities feel that the institution of a system of electrical inspection is for the welfare of the citizens at large. I feel that I have now taken up enough of your valuable time and I hope that in bringing this short address to a close that I will leave you all like the man who leaves the table feeling hungry, that is to say, that he can come back again and enjoy a little more at the next sitting.

The Consulting Engineer and the Contractor

By Mr. F. A. Vaughn

In considering the relation of the consulting engineer to the contractor, the element that "looms up" larger and more prominently than any other is that described by the magical, justly popular and perhaps much abused word "Co-operation." While there may be pleasant business, technical and social relations between the contractor and the engineer, the most essential relation by far is that of co-operation in the common service for the benefit of the customer of the contractor and the client of the engineer—of co-operation in order to secure for the individual, who pays for the services of both contractor and engineer, an installation of which all three may be justly proud.

You will, I believe, agree with the above analysis when I recall to your mind the many important advantages that accrue, not to the customer alone but to the contractor as well, by the type of co-operation referred to above. Every one of you would undoubtedly rather do good work than slovenly; rather use good material than poor; rather put in a complete and thorough installation in which you can take pride as well as make a profit, than to put in one in which you can only make a profit; you would also rather work against fair and equal competition than be subject to rash and unreasonable competition from irresponsible concerns.

With the above assumed premises established, the way is opened to the proper relation of the engineer to the contractor.

Every consulting engineer, who is worthy of his profession, naturally sets himself an ideal and a code of ethics that will build for him a reputation which will command the confidence of his clients in whose interests his efforts must be used in the broadest sense. He therefore must, by experience and other educational means, fit himself to know, for any particular client's installation and condition, what are the best and most dependable materials and methods. By specifying there in detail, the engineers will put all contractors on an equal basis, because they know in detail what is expected; will eliminate the possibility of "skimping," as well as the necessity of "playing safe" by excessive bidding to cover ambiguous points; will compel and popularize the use of good material and high grade workmanship because of its merits; will demonstrate, as a disinterested advisor to his client, the advantage and economies of good work, thereby establishing the proper relation between just compensation to the contractor and good value to the client; and will in general establish higher standards, the general adoption of which will eliminate the demand for cheap materials and cheap labor and by the establishment of these conditions will be establishing what is best for the client, the contractor and the engineer. This, then, is the co-operative part which the engineer should play in this triple relation. The contractor can do his share in the co-operation by giving the engineer the benefit of his experience and his conscientious efforts to comply with the specifications, to the end that the installation is praiseworthy and the client is satisfied that the money he has paid to both the engineer and the contractor is well invested.

By co-operation such as above described, the quality of engineering installation in the community will be raised and good workmanship will be at a premium as it should be; and this will all be accomplished without the efforts of the contractor, except, of course, the necessary and legitimate effort of doing good work according to specifications. Without the engineer in the field, clients are apt to ask and expect a contractor to "engineer" his installation, as well as to construct it, thereby forcing the contractor to labor, worry and expense that he probably is not willing to do, organized to do, or paid to do. His function is to construct, according to the requirements of the client, expressed through the specifications of the engineer, just as the engineer's function is to plan and specify, but not to construct.

It may be suggested that the engineer is an unnecessary factor because there is usually an architect connected with the work who is, or should be, able to specify all of the engineering features of an installation as well as the structural, architectural and artistic ones.

It is believed a little consideration will show that, in these days of wonderfully intricate, complete, comprehensive and often elaborate buildings which an architect is called upon to construct, and the tremendous strides and rapid advancements of all branches of applied sciences or engineering, an architect who devotes much of his time or energy to keeping sufficiently in touch with the engineering features of his installation is sacrificing the architectural side of his work which is the channel along which his very best efforts should progress, or else he is not devoting enough time and ability to master the engineering side; for the engineering branches involved in a modern installation—electrical engineering, mechanical engineering, heating and ventilating engineering, illuminating engineering, etc.—are highly technical and specialized branches which require different talents, character of mentality and foundations, than those found generally in men naturally equipped to be architects.

So in this co-operative scheme it is necessary to include the architect, and the same spirit of helpfulness for a common good should prevail throughout. The requirements of the client can now be thoroughly, intelligently and accurately specified in detail so as to insure a thorough understanding of them by the contractor without the necessity of imposing on his time or abilities; and it should be noted that the more minutely the specifications are written, the better insurance the contractor has that any competing concern will be required to furnish exactly what he himself has figured and the more assurance there is of equivalency of purpose and intention.

Specifications do not Specify

Specifications which do not specify are like laws which do not carry with them their own interpretation—they require the interpretation of the courts or other authority before they are really valuable. An architectural specification asking tersely for a "home to house a family of four" would appeal to all of us as highly inadequate and ridiculous; yet it is hardly more inadequate than an engineering specification for an "A.C., 220 volt generator of 250 kw. capacity" although it is believed the latter example is no exaggeration. In either case the client would get something which would perform the function he desired, in a way, but how satisfactorily is entirely unknown and indeterminate.

Brevity and terseness are much to be desired characteristics of any composition written or spoken; but unfortunately it is usually impossible, in a matter involving so many details as an electrical installation, to state those details in

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such . definite and exact way that there can be no uncertainty as to what is required, and yet make that statement a brief one. The only safe way, therefore, to secure what is required is for the engineer or architect to specify minutely all details of the installation, even though to do so involves great trouble and expense. By such exact and complete specifications, not only is the client assured of getting the best installation for the money expended, but the contractor is protected against unscrupulous persons bidding for and probably securing the contract for the work.

A consulting engineer is therefore to be regarded as a co-worker, in the truest sense of that word, with the contractor. The whole influence of any consulting engineer who measures up to his profession is in the direction, first, of protecting the reliable and high-grade contractor from unfair and cut-throat competition; and second, to educate the client to the wisdom of putting in a first-class installation, thereby enabling the contractor to get a fair profit for first-class work. A more general recognition of this ground of common interest between the contractor and the consulting engineer would do not a little to improve the conditions in the contracting field.

Electric Signs in Vancouver

The remarkable growth of business in Vancouver during recent years has lead to a great increase in the use of electric signs by local merchants and the city's rapid rise to the position of an important seaport and popular tourist centre has attracted the attention of firms which employ electric signs as the medium for conducting national advertising

Figs. 1, 2 and 3

campaigns. Nowhere throughout the city is the display of electric signs more in evidence than on Hastings and Granville streets, the two principal business thoroughfares which at night are ablaze with the glow of hundreds of signs of every conceivable description. The types of sign in use at Vancouver at the present time are divided into three classes, viz., "spectacular" signs, which illustrate some movement by automatic action; "flashing" signs in which there is intermittent display of either the whole sign or part of it, and "constant" signs with fixed light. What is considered to be the largest "spectacular" electric sign in Western Canada and the most successful in Vancouver, has been erected on the roof of a tall building on Hastings street east. This sign, Fig. 1, advertising a local brand of beer, measures 30 x 60 feet and is equipped with 625 four c.p. tungsten lamps for letters, outline, etc., and three 100-watt tungsten lamps with reflectors. During its operation the sign remains dark, except for the reflected light from the 100-watt tungstens on the neck band and label of the bottle. The tungsten lamps

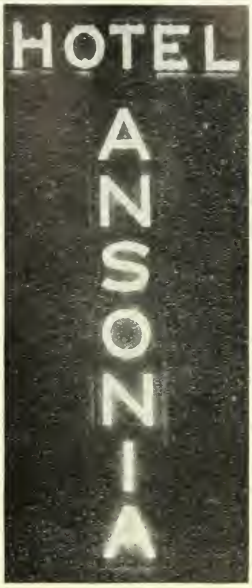


Fig. 4. Typical T sign

then show first, full bottle and glass outline flashes; second, stream starts, bottle empties, glass fills; third, stream disappears and glass foams; fourth, the word "Cascade" in red flashes on, followed immediately by the words in white "The Beer" and an instant later "Without a Peer," then all out and repeat.

The immense flashing sign owned by the wholesale grocery firm of Kelly, Douglas & Company affords a good illustration of the type it represents. The size of this sign is 48 x 90, see Fig. 2, and the number of lights, 779 5-watt tungstens. The color scheme consists of red for the name of the firm and the word "Nabob" with the bracketing design in green, and the balance of the sign in clear. While operating, the left side is "constant" covering the words "Use Nabob Brand"; the right side comprising the words, "Tea, Coffee, Spices, etc.," is "flashing," the words being shown one by one until the entire phrase is complete, then all out; all on and repeat.

The President Suspender sign, forming the Vancouver unit of a national advertising project, is displayed on Hastings street east. This sign is of a combination type, and measures 18 x 42 feet, Fig. 3. The bulletin to the left is illuminated by two 100-watt tungsten lamps. The space on the right is used as a "constant" electric sign in which 237 clear 5-watt tungsten lamps provide the necessary illumination.

The Patricia Lodge sign on Pender street west, is an excellent example of a type well suited to the requirements of

private hotels and similar establishments. In a sign of this class the use of leaded glass provides plenty of scope for working out a variety of attractive designs in a wide range of color. The Bijou Theatre sign on Carrall street, near Hastings, is a neat type illustrating how electric signs may be designed to meet special demands. Particular care has been taken to emphasize the advertising point in this

Fig. 5. Artistic sign in leaded glass

sign, the low admission price being prominently displayed. The sign is small compared to many in the vicinity, but owing to the fact that it is attached to the theatre at a good height above the street near a busy corner, it claims universal attention. The Hotel Ansonia sign placed at the corner of Dunsmuir and Howe streets illustrates the possibilities of the "T" sign, a type which, to judge from the large number in use throughout the city, has become popular in Vancouver. This sign is of the "constant" type, and measures 17 feet in height and 8 feet wide at the top. It is fitted with 180 tungsten lamps.

The different classes of electric signs dealt with in this article comprise a few of those which have been erected by

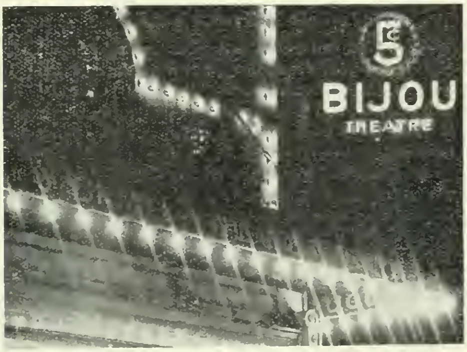


Fig. 6. Emphasis on low price

Abbott & Castleton, a well-known Vancouver firm of sign specialists. This firm not only attend to the building of the signs and the preparation of the equipment for operation, but also undertake their maintenance after being erected. It is worthy of mention that the latter practice is one that has not been associated with the work of the various large sign companies hailing from the United States which handle contracts for national advertising projects in Vancouver. In the manufacture of signs only the best material should be employed. Piping should never be used as the frame work for roof signs as it is liable to break at the joints, which are the weakest points. A member of the local firm mentioned above stated recently that they invariably use angle steel for roof construction, the size of the steel being in proportion to the dimensions of each individual sign.

With the exercise of care in the selection of materials proper methods of construction and constant inspection after erection, a sign may be guaranteed for two years. In Vancouver only 5-watt tungsten sign lamps are in use at the present time, but it is considered advisable on the score of economy and greater efficiency that 10-watt lamps should be substituted if possible.

Two kinds of color caps are being used on signs in the city, viz., "A" and "B" caps. The "A" type is a semi-cap, which covers the lower part of the bulb, and should be used only for roof signs. The "B" type is a whole cap covering the entire top of the bulb and is particularly suitable for street signs. Special rates for sign lighting in Vancouver are given by the B. C. Electric Railway Company in order to encourage the industry.

The Electric Vehicle Association

The Electric Vehicle Association of America have long since demonstrated their usefulness in the promotion of the use of electric motor cars and trucks. So rapid has been the expansion of the association's efforts and influences, and so voluminous has the development work become that the officers have for a long time found it extremely difficult to, at the same time, administer to the affairs of the association and do justice to their personal business. As a matter of fact, some of the officers have sacrificed their own private matters in the interests of the association. It has now been decided to establish the office of permanent executive secretary and inaugurate a system which will permit the centering and rapid dispatch of the association's work.

The association feel that they have been fortunate in securing the services of A. Jackson Marshall as their executive secretary, as Mr. Marshall is by nature and training, also inclination, admirably qualified to properly discharge the important duties of this office. Mr. Marshall has, until somewhat recently, been identified with the lighting world, having been one of the most progressive, energetic and successful exponents of "better lighting." Indeed, to him is attributed much that has become modern practice in the art and science of lighting. He is credited with originating much of the effective publicity which brought the subject of lighting to the attention of the layman as well as those actively associated with the industry.

Mr. Marshall is one of the best known personalities in the central station field, he having actively co-operated with most of the public utilities in the country. It is felt that his knowledge of central station conditions; his well-known respect for broad, consistent development and equitable relationships, and his original and interesting method of obtaining results will cause him to early prove a factor in the further success of the Electric Vehicle Association. During the last several months Mr. Marshall has been associated with the General Motors Truck Company, having been in charge of this company's business in Northern New Jersey.

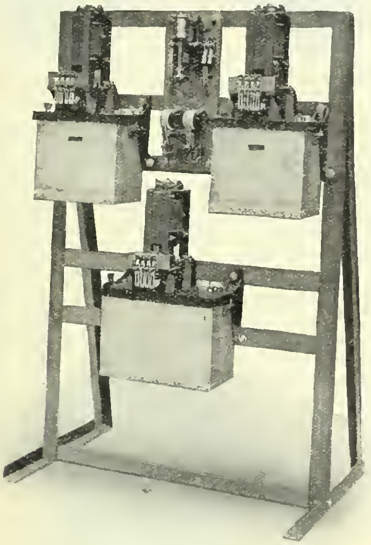
The new permanent head-quarters of the Electric Vehicle Association of America are now located at the United Engineering Society's Building, 29 West 39th Street, New York City.

The different large jobbers all over the country are sending out color mailing folders descriptive of the new "Oshkosh Guy Anchor."

New Automatic Controller for High Voltage Squirrel-Cage Motors

For centrifugal pumps and similar machines squirrel-cage motors connected directly to 1100 and 2200 volt three-phase systems are used to a considerable extent. The use of motors operating at line distributing voltages is frequently desirable for a number of reasons and for the automatic starting of these high tension motors a new line of self-starters has been designed by The Cutler-Hammer Manufacturing Company of Milwaukee. These controllers are of the multiple solenoid type consisting of an angle iron, floor type, self-supporting frame, which carries the high tension, oil-immersed, solenoid switches and necessary relays controlling the motor and auto-transformer circuits.

The oil-immersed type primary and starting switches used are operated by single-phase solenoids. All contacts are entirely enclosed under oil so that no live parts carry-

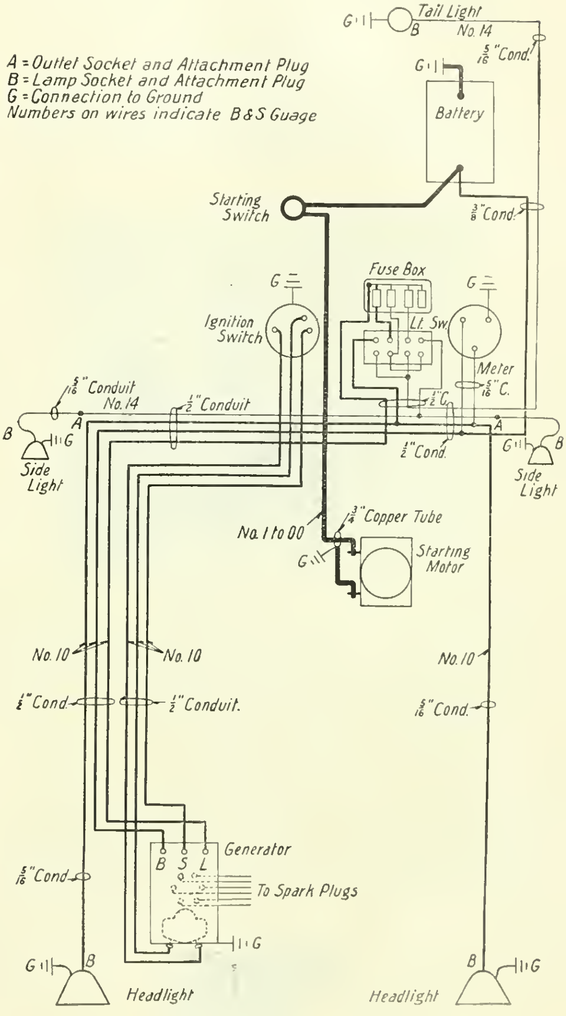


ing 1100 or 2200 volts are exposed. Low voltage current is used for the operation of the solenoid coils. The capacities of the standard types of these self starters range from 20 h.p. to 300 h.p., and are made for both 25 and 60-cycle, three-phase circuits. They can be automatically controlled when operating on an open tank system by means of a float switch and on a closed or compression tank system, by means of a gauge or diaphragm pressure regulator. For remote control from one or more points control stations can be employed so that the operator need only push the button to start or stop the motor.

The "S & C" extra high potential fuses are now being made in Canada by the Economy Fuse and Manufacturing Company of Canada, Limited, Montreal, under license from Schweitzer and Conrad, Chicago. Indoor and weatherproof types, with mountings for all conditions of installations, are made up to 110,000 volts.

Electric Equipment in Automobiles

A complete system of electrical equipment for automobiles is now being placed on the market by the Westinghouse Electric & Mfg. Company, the general design of which is shown in the accompanying line drawing. The lighting system alone consists of a generator and lighting switch for use in connection with a three cell, six volt storage battery.



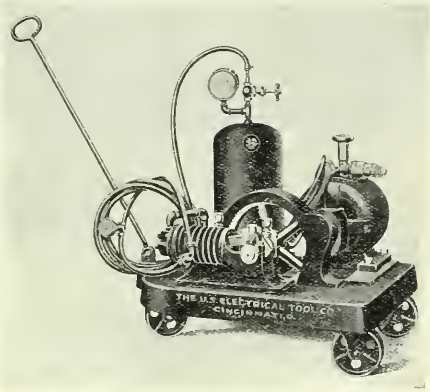
The ignition and lighting system consists in addition, only, of an ignition coil, a timer and a distributor as additional parts of the generator, with an ignition switch on the dash. The starting system consists of a six volt motor and a starting switch. Simplicity of wiring has resulted from having few parts to the equipment and from the use of the single wire ground-return system.

The system as installed by this company is regenerative; that is, when the engine is not operating or when it is running at very low speed, power for the spark, the line and the starting motor is furnished by a battery, and this power is returned to the battery when the car is running at the

usual speeds during the day and at higher speeds during the night. For such combined ignition and lighting it is essential that the instrument be such that a car can be operated on continuous night trips without exhausting the battery and on continuous day trips without injuriously overcharging it. In this system the generator has an output sufficient to carry an ample lighting equipment without drawing on the battery for power, and the design is such that at no time is the battery charged at an excessive rate.

A New Tire Pump

The illustration shows a new tire pump, suitable for public and private garages, which is sold by the U. S. Electrical Tool Company, Cincinnati, Ohio. It is simple and compact in construction, and being mounted on a truck it can be easily taken around the garage or outside to the curb. A tank 12



inches long by 6 inches diameter, into which the pump discharges, prevents condensation and oil from entering and injuring the tire. The pumping action is rapid, since a 35 x 4-inch tire can be pumped from flat to 70 lbs. in 1½ minutes. The motor is of Westinghouse make, ¼ horse-power in capacity, and can be operated from the lighting circuit.

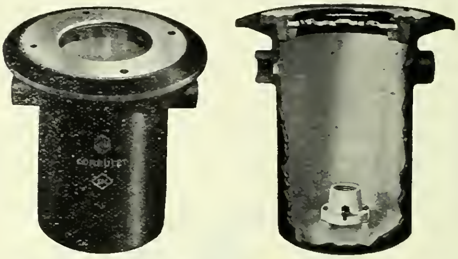
A Useful Door Switch

The cut herewith represents a useful type of switch manufactured by the Hart & Hegeman Manufacturing Company, through their Canadian agents the Canadian General Electric Company. The cut shown illustrates a switch that will operate either to close a circuit when the door closes and vice versa or to open the circuit when the door closes

and vice versa, the position of the contacts being reversible. Special claim is made for the durability of this unit and for the valuable feature that no matter whether the door swells or shrinks the switch is always operative.

Electric Lamps Under Water

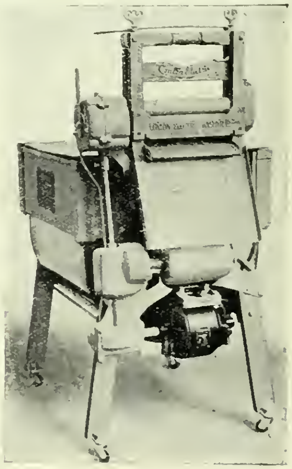
The illustrations herewith represent a new type of condulet known as the SP series, manufactured by the Crouse-Hinds Company of Canada. These are for use under water and take regular tungsten lamps up to 100 watt size or any lamp not exceeding 5½ x 8 in. in size. These condulets are designed to be set in the concrete at the bottom or sides



of swimming pools, fountains, etc., and provide watertight housings for lamps. The inner surfaces are white enameled, to reflect the light through a heavy plate glass disk in the top of the condulet. This glass disk is suitably secured in a heavy brass ring that engages a female thread on the body of the condulet. The ring can be removed at any time when not submerged, thus providing for lamp renewal. All joints are sealed with thick rubber gaskets of best quality.

A New Electric Washing Machine

One of the conspicuous features of the Electric Washer illustrated herewith is its complete safety. Every moving part is enclosed so that it is impossible to catch the fingers or the dress. The tension on the wringer rolls can be instantly removed by a patented release, thus preventing injury from this source to the operator or to the clothes. A friction clutch protects the motor in case of an overload. No belts or chains are used, the motor driving through a



steel worm and bronze worm gear which runs in hard grease; quiet operation is thus obtained. The motor and the drive are so located that they are out of the way and the whole machine is made neat and compact. The machine is lined throughout with metal, making it highly sanitary since there are no cracks and crevices to absorb dirty, soapy water. The

machine is made in three sizes, driven respectively by 1/6th, 1/5th, and ¼ h.p. Westinghouse electric motors which can wash and wring at the same time. It is manufactured by the Conlon Electric Washer Company, 312-320 North May street, Chicago, Ill.

Will hold Municipal Convention

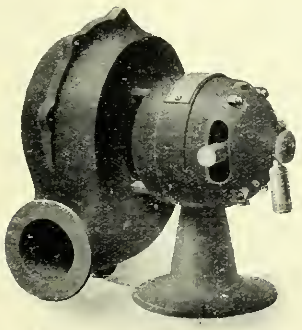
A meeting of the executive committee of the Ontario Municipal Electric Association was held in Toronto on Wednesday, the 18th inst., at which it was decided to arrange for a convention at which matters of technical and general interest will be discussed. A committee consisting of Messrs. H. H. Couzens, Toronto; E. I. Sifton, Hamilton; H. J. Glaubitz, London; P. D. Yates, St. Catharines; and E. M. Ashworth, secretary-treasurer of the Association, have the matter in hand.

A Large Order

The Herbert Morris Crane & Hoist Company, Toronto, announce that their English company have just received an order from the London & North Western Railway Company for ten 10-ton hand overhead travelling cranes and two electric cranes. This is in addition to a previous order for eight 12-ton hand cranes from the same company making this one of the largest orders on record.

A Small Capacity Blower

The cut herewith represents a Hamilton Beach motor direct connected to a centrifugal blower or exhaust fan. This exhaust fan gives a pressure of from 1¼ to 1½ inches on a water column and delivers about 165 cu. ft. of air per minute. The speed of the motor is variable. It is series



wound and universal on all currents of 110 volts. It is claimed to be an excellent machine to run forges, office ventilators, telephone booth ventilators, or indeed anything to be used in a place where a blower or exhaust fan of small capacity is required. Handled in Canada by R. E. T. Pringle.

Personal

Mr. P. D. Yates has been appointed manager and engineer of the St. Catharines Hydro-electric Commission.

Mr. L. Johnson, representing the Pulsometer Engineering Company, Limited, London, Eng., is making a business tour of Canada.

Mr. J. Antonisen, superintendent of the Brandon municipal street railway system, has resigned. He is being succeeded by Mr. Bowden.

Mr. W. P. Roper, formerly of Roper, Clarke & Company, has opened offices at 401 Lake of the Woods Building, Montreal, having been appointed eastern manager of the Canada Wire and Cable Company, Toronto, and district manager of the Canadian Moloney Electric Company, Windsor.

New Companies

Abitibi Power & Paper Company; capital $7,000,000, head office Montreal.

La Compagnie Electrique des Rivieries, capital $40,000, head office Notre Dame de Stanbridge, Que.

The General Electric Contracting Company has been incorporated with capital $10,000 and head office Vancouver.

The Interurban Company, Limited, has been granted a Dominion charter; capital $5,000,000; head office Toronto.

Trade Publications

Guy Anchor—A booklet descriptive of their new guy anchor being distributed by the Oshkosh Manufacturing Co.

Electric Fans.—Bulletin No. A4197, issued by the Canadian General Electric Company, describing and illustrating very completely the construction of their electric fans for 1914.

Graphic Meters—A booklet issued by the Esterline Company, Indianapolis, describing various types of graphic meters. The Esterline meter is a combination indicating and curve drawing instrument.

Moulded Insulation—A booklet issued by the Stevenson Company, Pittsburgh, Pa., describing the Stevenson moulded insulation and other moulded parts made from a number of different moulding mixtures, and claimed to be applicable to a wide range of uses.

Dumore—A folder published by the Wisconsin Electric Company, Racine, Wis., through their Canadian agents, R. E. T. Pringle, describing the Dumore suction cleaner—a small hand machine particularly valuable for the cleansing of upholstered furniture, clothing, etc.

Bell Transformers.—Pamphlet issued by Irving-Smith, Electrical Apparatus & Specialties, Montreal, describing two types of bell ringing transformers—Model B, suitable for moderately heavy work, delivering 7, 14 and 21 volts; Model C, a low capacity unit suitable for private residences.

Sight Flow Indicator.—Bulletin No. 57, issued by the Richardson-Phenix Company, Milwaukee, describing the Phenix sight flow indicator—a device for inserting in pipe lines which shows at a glance, or indicates electrically, whether or not the liquid is flowing. It is used in water lines of o.i.w.c. transformers, in the supply pipes and water jackets of gas engines, in circulating oil systems, etc.

Canadian Westinghouse—have recently distributed the following publications:—Circular 1104-9-13 describing the Westinghouse portable meter for alternating and direct current; circular No. 1165 describing Westinghouse electric fans, 1914 type; pamphlets descriptive of the following interesting subjects:—the electric breakfast set, the electric curling iron, the ozonizer sales helps, the latter for the use of dealers and their salesmen.

Door Safety Switches—An 8-page pamphlet on door safety switches for use with electric elevators has just been published by The Cutler-Hammer Manufacturing Company, of Milwaukee. A great majority of accidents on all types of elevators are the result of setting the elevator machine in motion before the doors are closed and locked and the passengers clear. With the ever-increasing number of passengers this safety feature is of utmost importance.

Current News and Notes

Bassano, Alta.

Tenders received for the construction of a telephone system in this town were not considered satisfactory and new tenders will be called later.

Berlin, Ont.

The gross receipts of the electric and power departments for the past year were $94,555 and net $14,384. Five per cent. has been allowed for depreciation. The street railway shows a net profit of $4,160. This is divided between Berlin and Waterloo in the proportion of three to one.

Brandon, Man.

The Brandon municipal electric railway system, as the result of a deficit in the neighborhood of $100 per day has found it necessary to take immediate steps to curtail the expenditures in connection with the operation of their road. As a result a large number of employees will be dispensed with, and the cars will be operated as one-man cars. It is also understood the schedule will be somewhat reduced and there will be no line extensions in the near future. It is hoped in this way to overtake the deficit account which has been piling up at an alarming rate. Following the resignation of Superintendent Antonisen, Mr. Bowden has been placed in charge of the much curtailed operations of the Brandon system.

Brantford, Ont.

After a keen competition, the contract for lighting the Congregational Church, Brantford, was awarded to the Western Counties Electric Company, at a rate of 2½c per kw.h.

The power customers of the Western Counties Electric Company have been notified that their lighting rates in future will be made the same as their power rates, namely, 3c per kw.h., with discounts.

Burford, Ont.

A by-law will be submitted to the ratepayers on March 9th to authorize the village council to make a contract with the Hydro-electric Power Commission of Ontario.

Burks Falls, Ont.

The Hydro-electric Power Commission of Ontario have been requested to investigate the possibility of power on the Magnetawan River to supply the Parry Sound district, and engineers will be sent to investigate the matter.

Calgary, Alta.

Tenders are received up to March 18 for two 12,000 volt, 3,000 kw. transformers for the city electric department.

A by-law will be submitted authorizing the expenditure of $300,000 for electric extensions of various sorts.

The gross earnings of the Calgary Power Company during last year were $240,116, an increase of $47,770, while the net increased $26,353, the surplus, after interest charges, being $88,026. Mr. E. B. Bennett, the president, in his report states: "The fourth unit at Horse Shoe Falls plant was installed during the year, bringing the equipment at that point up to its ultimate capacity. An entirely new development was constructed by the company's force during 1913 at the Kananaskis Falls, a distance of two miles above the Horse Shoe Falls development, and the first 6,000 h.p. unit was put into service on December 27th. Another 6,000 h.p. unit is now being installed, thus completing all construction work at present in hand. There are now duplicate transmission lines to Calgary, and a third to Exshaw was installed during the year for the purpose of avoiding any possible transmission trouble. Among other contracts the company has one with the city of Calgary, providing for a supply of a minimum of 5,000 h.p. to be used by the city for the operation of its municipally-owned street railway, electric lighting and power departments.

Cape Breton, N.S.

The gross earnings of the Cape Breton Electric Company for the year ending December 31, 1913, show an increase of $20,775 in gross and $5,702 in net for the past year.

Chatham, Ont.

An electric railway line connecting Thamesville and Sombra is reported to be in prospect. Mr. T. M. Little, one of those interested, is said to have stated that work will be commenced early in the spring.

Clinton, Ont.

The town of Clinton was lighted for the first time by Niagara Falls power on the evening of February 15.

Cobalt, Ont.

The installation of electrical machinery at Fountain Falls, Montreal River, being undertaken by the Northern Ontario Light & Power Company is held up temporarily pending the arrival of the generators. The turbines are now being placed in position.

Elk Lake, Ont.

Mr. A. J. Reece, owner of the Elk Lake telephone and telegraph line, has sold out to the T. & N. O. Railway Commission.

Fort William, Ont.

The programme in connection with the street railway system for the year 1914 includes an auxiliary line right across the city. Sufficient money has been voted for this work.

Galt, Ont.

A radial railway line from Galt to Hamilton has been proposed; information will be obtained as to the probable cost and earnings of the road and an effort will be made to interest the municipalities along the line.

Halifax, N.S.

At the last session of the Nova Scotia legislature an act was passed providing for the appointment of a commission to inquire into the application of electricity in the coal mines of the province. The personnel of the committee which was recently appointed is as follows:—Judge Patterson, New Glasgow, chairman; T. J. Brown, Superintendent, Nova Scotia Steel & Coal Co.; V. McFadden, chief electrician of the Dominion Coal Co.; John Moffat, Glace Bay; and Henry Perrin, Spring Hill. The commission have already paid a visit to the coal fields of the Maritime Coal, Railway & Power Company, Joggins Mines, as being the best electrically equipped mine in the province. Several mine centers will be visited in the near future and it is understood the commission will make a report in the early summer.

The gross earnings of the Halifax Electric Tramway Company for the year 1913 were $605,933, as against $539,953 in 1912. Net for the past year was $337,008, an increase of $50,448 over the previous year. The receipts of the Electric Light & Power Department were $242,085, as against

$228,654 a year ago. Mr. E. A. Robert, Montreal, is president of the company, and Mr. O. E. Smith, Halifax, vice-president.

Hamilton, Ont.

The report of the Dominion Power & Transmission Company for the year 1913 as presented by J. R. Moodie, president, at the annual meeting, shows gross earnings for the year as $2,737,806, an increase of $174,455. The considerable sum of $442,677 was set aside for renewals and maintenance, of which $337,270 was actually expended, the balance being placed to the credit of this account. The report speaks also of work at present under way in connection with their immense steam plant and in railway line and rolling stock extensions. At the annual meeting it was also stated that the company had in mind the construction of a branch line off the Brantford and Hamilton section at a point near Langford to Galt which would effect a comparatively direct road between Galt and the city of Hamilton.

The installation of two 4,000,000 gallon pumps has been recommended by the city engineer and will be passed upon by council.

A steam auxiliary plant in connection with the waterworks system is under consideration by the Board of Control.

Havelock, Ont.

The town council have requested the Hydro-electric Power Commission of Ontario to submit estimates regarding the supply of light and power.

Huntsville, Ont.

Negotiations are proceeding between the Huntsville council and the Bracebridge electric light commission regarding a supply of electricity in Huntsville from the Bracebridge plants.

Kamloops, B.C.

Mr. T. R. Cornick, contracting engineer, Vancouver, was recently awarded an important contract covering the erection of 43 miles of wooden pole transmission line for the city of Kamloops between the city's hydro-electric generating station on Barriere River and the sub-station in Kamloops. The contract calls for the use of 45-foot wooden poles with steel core aluminium conductors, equivalent to No. 4, B & S. gauge solid copper. Spans will average 200 feet. This will be a 45,000 volt line using pin type insulators manufactured by the Locke Insulator Company. The line will carry a ground wire at the peak, and one metallic telephone circuit. Du Cane, Dutcher & Company, Vancouver, are the consulting engineers for the city of Kamloops in connection with the extensive scheme of hydro-electric development, of which this work will form a part.

Kalso, B.C.

This city is negotiating for the purchase of the distribution plant of the Kootenay Electric Company, Limited.

Listowel, Ont.

At a meeting of representatives from the counties of Bruce, Grey, Perth, Wellington, and Huron held recently at Listowel, the delegates formed themselves into the North-western Ontario Hydro Association, for the purpose of undertaking negotiations with the Ontario Hydro-electric Power Commission regarding the supply and distribution of electric power in their district.

Marmora, Ont.

The North Mutual Rural Telephone Company has been organized here with 22 shareholders and it is expected about ten miles of line will be put in during the present summer. Chas. Jones is the secretary-treasurer.

Moncton, N.B.

The city council have authorized the preparation of plans and specifications for a new system of street lighting.

Montreal, Que.

Plans have been prepared by the Electrical Service Commission, Montreal, for laying additional conduits, for which tenders will be called early in the spring. Four separate plans are being drawn up dealing with conduits for the business section, these including the intersecting streets as well as the main thoroughfares. The chief streets on which the conduits are to be built are: St. Lawrence Boulevard, from Sherbrooke street to the river front; Craig street, from McGill street to St. Lawrence Boulevard; portions of Fortification Lane, St. James street, Notre Dame street, and both sides of Victoria Square. A special conduit for the Montreal Tramways Company will be constructed from the company's power house, William street to McGill street, where it will link up with the general scheme. Preparations are being made for the wires being drawn in the conduits already constructed; this will take a considerable time, as in certain instances work can only be done at nights and on Sundays.

At a recent meeting of the directors of the Canadian British Insulated Company, Limited, Montreal, Mr. Cyril G. Savage was appointed secretary-treasurer in succession to Mr. H. Brown, resigned.

The Montreal Tramways Company have put several trailers (a description of which has appeared in the Electrical News) on the St. Catherine Street route. Mr. J. E. Hutcheson, the manager of the company, has expressed the opinion that, as the result of the short experience, the cars will contribute to eliminate the crowded conditions which have hitherto existed. The trailer is boarded from the front, the end portion being entirely utilized for seating accommodation.

The Northern Electric Company, Limited, recently incorporated with a capital of $10,000,000, will absorb the Northern Electric and Manufacturing Company, Limited, and the Imperial Wire and Cable Company, Limited, Montreal. Both the latter companies have been in working alliance, and they will now be merged under the new name, the present names of the two concerns being dropped when the new company comes into working order. As we have already mentioned, the Imperial Wire and Cable Company are now building a very extensive new plant in Montreal, which will largely increase their present capacity.

Moose Jaw, Sask.

The issue of $50,000 new stock made by the Moose Jaw Street Railway Company was eagerly subscribed by the present shareholders, who are greatly pleased with the efficient management of the concern.

Ottawa

A company called the Niagara-Welland Power Company is seeking the consent of parliament to develop and sell power that will be made available by the construction of the new Welland Canal. The matter will be submitted to the Ontario Hydro-electric Commission before any definite steps are taken.

Plattsville, Ont.

A by-law recently passed authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario for a supply of electric energy.

Port Arthur, Ont.

The Bergman Electric Company is opening a new electric supply store here about the 1st of March.

The net earnings of the Port Arthur end of the electric railway line, for the month of January, were $10,129, as compared with Fort William's earnings of $11,004.

Preston, Ont.

Alterations and extensions to the electric lighting system are contemplated.

Regina, Sask.

The operating returns of the municipal street railway system for the week ending January 31 are as follows:—revenue, $4,293.85; passengers carried, 100,987; passengers carried including transfers, 112,213. For the week ending February 7 corresponding figures are $4,536.20; 107,353 and 119,982; and for week ending February 14 $4,110.50, 100,828, 112,787.

Railway extensions to the amount of approximately six miles, rolling stock to include four double truck cars and a certain amount of feeder lines have been approved by the city council.

Reserve Jct., N.S.

The new turbo-egenerator of the Cape Breton Electric Company has been placed in operation at this point.

Saskatoon, Sask.

The city council at a recent meeting decided to extend their street car line though the 19th street subway.

The city council has entered into an agreement to supply power to the Northland Milling Company, located at Factoria, on the northern outskirts of this city. The price will be two cents per kw. hour. An overhead line will be constructed from the city power house at Factoria. The city will bear the expense of the line from the power house to the city limits, and the milling company will there take over the line and construct it the remainder of the way. The company's plant is now ready to operate and has a capacity of 700 barrels per day, capable of enlargement to 1,500 barrels. This is the second large United States milling concern to establish here within the past two years, the other being the sole western plant of the Quaker Oats Company.

The receipts of the municipally owned and operated electric street railway system continue to encourage. For last month a total of 320,661 passengers were carried, which with the total receipts shows an increase in traffic of six and a quarter per cent. The total mileage of the month was 62,370 miles. The average amount paid by each passenger was 4.447 cents. On the Sutherland line the average passenger paid the amount of 9.294 and a total of 15,231 people were carried on this line during the month. The fact that Saskatoon's population is about 30,000, and that more than that number used the cars every three days of the past month, is considered by the officials to be very satisfactory.

South Porcupine, Ont.

The Canadian Allis-Chalmers, Limited, have recently shipped for the Dome Lake Mining & Milling Comyany the following equipment:—Two 175 kv.a., oil filled, self-cooled transformers, 12,000/550 volts, 25 cycles; one 150 h.p. slip-ring, wound rotor type motor, 480 r.p.m., 550 volts, 25 cycles, 3-phase; one 52 h.p. slip-ring, variable speed, 720 r.p.m., 3-phase, 25 cycle, 550 volt hoist motor fitted with extended shaft for herringbone gear and out-bearing solenoid brake, reversible brake, etc.; one 12,000 volt aluminium lightning arrester; switchboard, circuit breaker, etc. The equipment will be installed by Mr. Geo. McDowell, electrician for the Hudson Bay Mines Company, Cobalt.

Strathroy, Ont.

The by-law carried by a considerable majority authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario for a supply of light and power from Niagara Falls.

Thornhill, Ont.

A recommendation has been made by the property committee that an agreement be entered into with the Toronto & York Radial Railway Company to supply electric power and light to the industrial farm near Thornhill. The rate is understood to be 8c per kw.h. for the first 30 hours' use of installed capacity with a graded scale for consumption in excess of this amount.

Timmins, Ont.

The Northern Canada Power Company are installing an electric plant at Timmins, Ont.

Toronto, Ont.

Tenders are received for transformers up to March 12 by the Toronto Hydro-electric Power Commission.

An important meeting of the Hydro-electric Power Commission of Ontario was held on February 11 at which it was decided to proceed immediately with the construction of a duplicate high voltage line between Niagara Falls and Dundas. This will probably be the busiest season the Hydro Commission have yet experienced, work at present under way including the extension of the line from St. Thomas west to Windsor, the construction of a 46,000 volt line from Niagara Falls to Welland, particularly for power purposes, the development of Eugenia Falls and the distribution of this power, to say nothing of the possibilities of radial railway lines.

Following the failure of the Toronto Railway Company to remove snow from the streets as ordered by Commissioner of Works Harris, Corporation Counsel Geary has been requested to take action in the courts to compel the company to observe the order. The snow referred to is that thrown to the sides of the track by the company's snow sweepers.

The Board of Control have reached a decision to install steam equipment for operating the waterworks pumps and a scheme has been brought forward by which this can be made a part of a larger steam stand-by plant to act as a safeguard in case of trouble in the high tension transmission line.

Transcona, Man.

A by-law has been passed in the legislative railway committee granting power to Transcona to construct, maintain and operate a street railway in the town.

Vernon, B.C.

A by-law will probably be submitted in the near future calling for the expenditure of $11,000 on electric light extensions.

Waskada, Man.

The matter of a municipal electric plant to supply light to the residences and streets is under consideration.

Winnipeg, Man.

A contract has been awarded to the Canadian Allis-Chalmers, Limited, for head-gate and head-gate lifting mechanism, etc., for power plant extensions at Point du Bois.

Woodbridge, Ont.

The Hydro-electric Power Commission of Ontario have quoted the village of Woodbridge a price of $38.50 per h.p. and it is probable a vote will be taken in April.

New Books

Modern Seismology.—By G. W. Walker, F.R.S., being one of a series of monographs on physics edited by Sir J. J. Thompson, F.R.S., and published by Longmans, Green & Company, London. The publishers' agents for the Dominion of Canada and Newfoundland are the Renouf Publishing Company, 25 McGill College Avenue, Montreal, Que. The book is written from the point of view of seismology as a branch of physics and particularly as it is determined by observatory conditions. The author has had wide experience with the installation and operation of seismographs and his treatment of the subject is at the same time interesting and authoritative. The book is well illustrated; price $1.50 net.

Electrical News

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Power Export Should Stop

In their decision on the application of the Canadian-American Power Corporation to import 46,000 h.p. of electric energy from Canada and distribute it in New York State the Public Service Commission of New York have raised once more that interesting question of the value of the proviso that Canada is allowing power to be exported to the United States only until such time as the Canadian industrial activities shall require its use in Canada. As we have pointed out more than once it is an easy matter to insert such a proviso in an agreement but it is an entirely different matter to enforce the proviso.

The Public Service Commission evidently take it for granted that there is no intention on the part of Canada of ever laying claim to power which is once allowed to be exported into the United States, the exact words of the decision being:—

"We have nothing before us but the suggestion that the Dominion of Canada may at some future time forbid this exportation. This commission must assume that international relations affecting so important a subject as the means of continuing great industries which have grown up in reliance upon the use of this imported power, and as well the interests of the Canadian producing companies themselves, have become fixed and subject only to such changes as will fully protect the great commercial and industrial interests and rights now served by this power brought from Canada. The time has long since passed when governments proceed ruthlessly from pure national rashness or anger to destroy the settled accepted commercial relations and formally vested rights of persons and corporations."

In this decision it is equally evident that they recognize Canada's right to prohibit the export and that they assume the impossibility of enforcing such a condition. Great commercial industries which have been built up in the United States by the use of Canadian electric energy must be protected. It is more than possible this commission does not over estimate the difficulties in the way of Canada's reclaiming power that we have once allowed to slip through our fingers. It is all the more important, therefore, that we should prevent any more exportation. The demand for electric power on the Canadian side has grown beyond the expectation of the most sanguine electric enthusiast and we are already within measurable distance of the time when Niagara Power will be insufficient to supply the needs of Western Ontario. This is a matter of very prime importance to Ontario and Canada as a whole. It seems most unfortunate that at the moment when our enthusiastic Ontario municipalities are preparing to construct hydro-radials throughout the province, the means of operating these radials should be gradually slipping away from us.

Important Resolutions

At a largely attended banquet of delegates of the Hydro-electric Railway Union held in Guelph on February 27, three important resolutions were unanimously adopted. As was pointed out, the treatment accorded private companies in the past should surely be accorded the people of Ontario who want to construct their own roads and it can, no doubt, be taken for granted that the subsidy asked will be forthcoming. The question of power supply is even more important. In something less than three years, a contract limit which was looked upon as sufficient provision for a generation to come, has been practically reached. There is no doubt the electors will back the Government in any move they may make towards the conservation and increased distribution of electric energy for the use of the general public. The resolutions follow:—

1. That they ask the Dominion Government for the usual subsidy of $6,400 a mile for important lines of railway to be built by the Hydro-electric Power Commission of Ontario. Private companies have invariably received such aid and the people's own line should receive the same treatment, resulting in cheaper living and better transportation. Such accommodation wherever supplied has doubled and tripled the value of land.

2. To ask the assistance of the Dominion Government in finding means to greatly increase the amount of power in the Niagara peninsula for the use of the Hydro-electric Power Commission; their power under contract at present being only 100,000 horse-power which will be practically all in use at the end of the year; it being understood there are several methods by which a greatly increased supply of power can be secured, providing the Dominion government is willing to assist in the solution; such power being absolutely necessary to provide for hydro-electric railways and increased consumption in western Ontario.

3. To ask an ocean waterway of 35 feet in depth from Montreal via the St. Lawrence and the lakes to Port Arthur and Fort William, and that the international features of the project be taken up with the United States for the earliest possible solution, it being understood that the improvement of the St. Lawrence will of itself supply eastern Ontario with millions of horse-power of electrical energy, greatly to the benefit of manufacturers, cities and towns and the farming communities with the view that hydro-electric power become universally used for the whole benefit of the people, urban and suburban.

D. C. Railway Electrification

The regular monthly meeting of the Toronto section of the A. I. E. E. was held in the Chemistry & Mining Building of the University of Toronto on Friday evening, March 6. The speaker was Mr. Geo. H. Hill, of the General Electric Company, Schenectady, N.Y., who presented a paper on "High Tension Direct Current Railways." Mr. Hill prefaced his paper by a very interesting picture of the first electric car ever operated. This was in 1879, when the Siemans Company built a very primitive though utilitarian electric passenger car which operated in Berlin.

Mr. Hill's remarks dealt chiefly with the value of electrification on heavy freight terminals, grades and tunnels, all of which were capable of being considered on an economic basis. It was pointed out that safety to human life also rendered the operation of tunnels by electricity an absolute necessity. Regarding the electrification of mountainous sections of country the speaker stated that while a 4 per cent. grade represents the extreme limit of the steam engine, electric locomotives will operate on such a grade and maintain a schedule of 25 miles per hour.

The Butte-Anaconda, the first and only American road as yet operated on 2400 volts d.c., formed the text of a very interesting moving picture illustrated talk on high voltage d.c. electrification. On this road it has been shown that the cost of fuel is approximately 60 per cent. of what it had been under the old system and the total cost of operation is approximately 50 per cent. of what it was with steam.

An interesting phase of the question as discussed by Mr. Hill had reference to the overhead construction. Formerly it was the practice to suspend trolley wires in rigid framework maintaining flexibility only in the collecting device. The present, system, which is giving much better satisfaction, is to make the collector rigid and obtain all possible flexibility in the suspension of the overhead trolley wire. To obtain this the trolley wire is suspended by loops from a wire above, the loops being movable up and down as required to keep the tension constant. One of the most interesting pictures shown was that of a train entering a terminal station with rigid collector which consisted of a metal cylinder five inches in diameter and approximately four feet long passing from one trolley wire to another. The various trolley wires are not connected but are brought, in an approximately parallel direction, to within a few inches of one another. In this way the cylindrical collector may pass from one to the other and may happen to be operated from one-half dozen or more trolleys at the same time, as was shown in this picture. The efficiency of the flexible scheme of suspension of the trolley wire was shown in this illustration also to splendid advantage.

Steam as a Prime Mover

In these days of rapid changes and developments the purchaser of generating equipment is often undecided what type of prime mover is best suited to his individual requirements. This is especially true in the field of the steam engine, where there are now a number of types each, within very fair limits, filling its own little gap in the matter of varying capacities and filling it more cheaply, both as to initial and operating cost, than any of the other types can do. The field of the various types of steam-engine-generator is discussed carefully in a paper by Mr. G. Percy Cole, printed elsewhere in this issue and interesting curves are attached showing the approximate cost of equipment (including electric generators) varying in size from 3 kw. up to 10,000 kw. The paper divides the full scale into four sections somewhat as follows:—(1) Marine type, 3—35 kw. (2) Horizontal reciprocating 35 to 150 kw. (3) Vertical compound reciprocating 100 to 500 kw. and (4) Turbo generators up to 10,000 kw. Units as high as 35,000 in the latter type are now in use. The paper also includes valuable operative cost figures. Inasmuch as Mr. Cole has been intimately in touch with the figures discussed in this paper and speaks with the authority born of recent and close contact we specially commend the article to our readers.

Copper Production in Canada During 1913

A preliminary report on the mineral production of Canada for the year 1913 has just been issued by the Department of Mines. This report was prepared by Mr. John McLeish, B.A., chief of the division of Mineral Resources & Statistics. The production of copper for the year amounted to 76,975,832 pounds, which, at a value of 15.269c per pound, amounted to $11,753,440. Both the quantity produced and the price per pound are slightly less than for 1912, the former figures being 77,832,127 pounds at 16.341c per pound. The price of copper, however, shows a considerable increase over former years as for the four previous years 1908-1911 it ranged between 12.3 and 13.2c per pound.

The Canadian production of copper is represented by the copper contents of smelter products, matte, blister copper, etc., together with the amount of copper contained in ores exported, estimated as recoverable. Quebec province is credited with a production of 3,455,887 pounds as against 3,282,210 pounds in 1912, the increase being due to the increased production from the pyritic ores of the Eastern Townships. Ontario's production in 1913 was 25,884,836 pounds as compared with 22,250,601 pounds in 1912 being mainly derived from the nickel-copper ores of the Sudbury district. British Columbia had an output of 45,791,579 pounds. From the Yukon the Pueblo Mine was the heaviest shipper. The New York price of electrolytic copper varied during the year between 17.45 cents per pound in January and 14.05 in December, the average for the year being 15.269 cents as against an average monthly price of 16.341 cents in 1912. The total imports of copper in 1913 were valued at $7,415,008, divided into crude and manufactured 41,011,961 pounds valued at $6,935,822, other manufactures valued at $371,226, copper sulphate 2,037,714 pounds valued at $107,960. The exports of copper were:fine in ore, matte, etc.. 81,879,080 pounds valued at $9,479,480, black in pigs 771,280 pounds valued at $123,431.

New Sub-stations of O. E. R. Co.

Two new sub-stations have just been put into operation by the Ottawa Electric Railway Company, at a cost of $60,000 each. One of these new stations is on Nelson street, near Rideau, designed to supply increased power to the eastern section of the city; the other is on Center street to supply the south-western district. The company now has four such stations in operation, the other two, which were opened some time ago, being at Albert street and Britannia.

The new buildings are fireproof structures, built of brick with concrete roofs, floors and foundations, the dimensions being 32 ft. by 32 ft. and 25 ft. high, well ventilated and lighted. These buildings have three different systems of lighting —by an a.c. supply from the Ottawa Electric Company; by a d.c. supply from the generator, and by a gas lighting system, any one of which may be used in case of trouble on the others. The Rector Automatic gas heating system is installed in both stations.

The motor-generator sets installed in these stations and the switchboards apparatus were all supplied by the Canadian Westinghouse Company. Each of the motors is a 950 h.p., 2-phase, four wire, 2,200 volt, 60-cycle, unit running at 500 r.p.m. at full load. The motors are directly connected to a 650 k.w., 600 volt, d.c., interpole generator. These sets are

started up from rest from the d.c. end by a special starting switch and set of grid resistors.

The switchboard for each of the above sets consists of two panels of blue Vermont marble, polished, with bevelled edges, mounted in an angle iron frame supported from the wall by backstays. Mounted on the a.c. panel are an ammeter and wattmeter for each phase, a voltmeter which can be connected to either phase, a polyphase kilowatt-hour meter connected to both phases recording all power used to operate the motor, and one 3,300 volt, 4-pole, 400 ampere, oil switch with overload and no voltage coils.

Mounted on the d.c. panel are one 1,800 ampere, single-pole, automatic circuit breaker fitted with carbon contacts, one 600 volt, d.c. voltmeter, one 1,800 ampere, 600 volt ammeter, one 25 ampere, 600 volt field ammeter, one two-point voltmeter switch, one field rheostat mounting, two 1,200 ampere, 600 volt, single-pole, single throw knife blade contact switches, one five-point motor starting switch used for starting up from the generator end, and the pilot lamps for illuminating the instrument dials.

Behind the board are installed and mounted all instrument transformers, cut outs, fuses, oil switch tanks, field rheostat, field discharge resistance, starting grid resistors, lightning arrester and bus bars.

The power to operate these sets is generated at the company's main power house, provision being made with switching apparatus that in case of emergency they can be connected to any one of the several power houses. The power from the main power house is transmitted by overhead four-wire, two-phase, 2,200 volts, to each of the sub-stations. Between the power lines and sub-stations and all through the sub-stations, paper insulated lead covered cables are used, installed in underground conduit, as well as for the d.c. trolley feeders and rail return circuit.

Electric Equipment in Making Pulp and Paper

The secret of the economical production of cheap pulp and paper is abundant water power capable of economical development, in part at least, into electric energy. The Brompton Pulp & Paper Company has a water power just below Bromptonville on the St. Francis River six miles from Sherbrooke. At first the water power was only used to operate turbines which were direct connected to the grinders, 14 of which were initially installed. Since that time, seven additional grinders have been put in until the capacity is 140 tons per day. The available horse-power is approximately 10,000 for six months in the year. The following electrical equipment situated at East Angus has been installed in connection with this plant:—One 950 kw. generator direct-connected to a pair of turbines of 1,500 h.p. at 214 r.p.m. and one 250 kw. generator direct connected to a pair of 21 in. turbines of 400 h.p. These generators are at mill No. 4. The power is generated at 2,250 volt, single-phase, 30-cycles and transmitted to mill No. 5, the box board mill, where there is a sub-station containing the transformers and distributing switch board. Mill No. 4, or power house, is about one mile from 3-5-6 and saw mill to which the power is transmitted, where the power is distributed to mills No.s 3-5-6 and sawmill.

Mill No. 5, which is all driven by direct connected motors contains one 150 h.p., three 50 h.p., nine 25 h.p., and thirteen 15 h.p. motors; the motors being direct-connected to wet machines, screens and pumps.

Mill No. 3 contains:—one 150 h.p., one 75 h.p., one 50 h.p., six 25 h.p., one 20 h.p., three 15 h.p., and one 10 h.p. These are mostly belted motors.

Mill No. 6 contains:—one 150 h.p., one 75 h.p., one 50 h.p. and two 15 h.p.; these are belted except one 150 and one 50 h.p. which are connected to line shaft with flexible couplings.

The saw mill contains:—one 150 h.p., one 100 h.p., one 15 h.p. The 150 h.p. unit is direct connected to line shaft with flexible couplings; the others are belted.

All motors 50 h.p. and larger are 220 volts and all smaller motors 550 volts. Sub-station at mill No. 5 contains four 150 kw. transformers, 2,250/550 volts for motor circuit and three 10 kw. transformers 2,250/110 for lighting.

The machinery in mills 3-6 and the saw mill is divided into groups so as to require the least possible amount of shafting and belting and so that each group is a department by itself as much as possible. By this means the stoppage of any one department will not interfere with another. The power plant and distribution system were all designed by C. A. Ring, chief engineer, who also designed and superintended the construction of the mills.

Mixed Pressure Turbo-Generator

The Nova Scotia Steel & Coal Company have had in successful operation for some time, a 750 kw. mixed low pressure turbine unit, a view of which is shown in the cut herewith. This set supplies power to the new developments in the collieries, also to a new electric hoist and various motors.

The set has an output of 750 kw. at 80 per cent. power factor, 2200 volts, 3-phase, 60 cycles, speed 3600 r.p.m. A direct coupled overhung type exciter is provided. The stator is fully enclosed in a substantial cast-iron shell provided with a special air inlet and air outlet. The ventilating air is drawn in and expelled by the action of fans attached to the rotor. On entering the generator the air divides into two separate and independent streams, passing through the stator and rotor respectively in a direction parallel to the axis of the shaft. In the stator the air flows through a number of apertures in the body of the stator iron, and also passes immediately next to and along the entire length of each stator conductor. The same method is applied to the rotor coils. By the use of the axial method of ventilation, vent spacers between the core plates are eliminated. Further, as the air feeding the rotor passes through from end to end and does not emerge at intervals to impinge upon the stator, a more quiet running machine is obtained. Lastly, since the air passes axially through the generator, the hottest part of the stator will be that end remote from the cool air supply, and this is accessible to a thermometer.

The rotor consists of a solid steel forging in one with the shaft. In this the slots and ventilating ducts are planned out. Certain slots have air spaces at the sides as well as the base, the cooling of the conductors being most carefully considered. The slots are radial and open, the conductors consisting of copper strip lying flat in the slots and being turned on edge in the overhang. The strip is continuous so that there are no joints in the windings of one coil.

The coils are secured to the slots by means of heavy metal wedges, and in the overhang by means of solid metal winding covers which are shrunk on over an insulating layer of presspahn and registered on machined surfaces at either end. The use of these covers obviates the use of binding wire such as is used on slow speed machines. Moreover, a cover can, in a case of necessity, be quickly and easily removed. Lastly, with axial ventilation, it is unnecessary to cut deep radial grooves in the surface of the forging, so that the stiffening effect of the solid teeth is not impaired throughout their length, in fact, from the point of view of rigidity, the rotor may be said to be "all shaft."

The high pressure steam is supplied to the turbine at 200 lbs. from a battery of Stirling boilers fired by coke oven gases. The turbine also works on mixed pressure low pres-

sure steam supplied from the exhaust of two large vertical engines.

There is also a five-panel switchboard equipped with the necessary oil switches, indicating instruments, disconnecting switches, etc. All the electrical equipment was supplied by the Siemens Company of Canada, the steam turbine being supplied by Fraser & Chalmers of Canada, Limited.

Interesting History

"The History of the B. C. Electric" was the subject of an interesting address delivered recently by Mr. F. R. Glover, general executive assistant, before a large and appreciative gathering in the draughting room of the company's head office at Vancouver. Mr. Glover, whose connection with the company extends over a period of twelve years, and whose knowledge of the subject is thorough, treated his audience to a history of the street railway business on the lower mainland of British Columbia from its earliest infancy to the present day. His opening remarks disclosed the fact that the first electrically-driven street car in Canada was operated by the company in Victoria, that city running its first car early in February, 1889. The first car to be operated in Vancouver was run out of the company's barns on July 1, 1889. Mr. J. W. Paxton, who was present at the address, being the motorman. The original section of line built in Vancouver was from Front Street down Main to Powell, then Carrall to Cordova street, Cambie, Hastings to Granville, then to Drake street, which was at that time the terminus. Several humorous incidents were told by Mr. Glover about the time when the motorman and conductor were one and the same man. He described how the "motorman" had to stop his car while the "conductor" went inside and collected the fares.

Another amusing phase of the company's early tribulations was the fact that in those days the grade on Cambie street between Cordova and Hastings proved an immense obstacle to the running of the cars, the passengers being frequently obliged to alight and push the car round the Hastings street corner!

As an instance of the growth of Vancouver, Mr. Glover quoted the fact that at the time the Robson street branch was opened in 1895 the company awarded free passes to anyone who would undertake to live in that district, many people, prominent to-day, gladly availing themselves of the offer of the free transportation.

In 1890 the New Westminster line came into being, and the interurban line connecting that city and Vancouver was also built. In 1891 owing to the extremely hard times in this country and province, the Vancouver company, finding itself in financial difficulties, offered its business as a going concern to the city for $410,000, but were refused. The offer was repeated in 1893 and 1894 at much reduced figures, the city in each instance refusing to make the deal. Mr. R. N. Horne Payne saved the situation in 1895, by interesting British capital in the concern and through his efforts the Railway Amalgamation Syndicate which was the solid foundation on which the present system was built, and which embraced the Victoria, Vancouver and New Westminster systems, came into existence. The B. C. Electric Railway Company was incorporated in April, 1897, with an initial capital of $250,000, Mr. J. Buntzen being made manager of the concern and Mr. Sperling the electrical expert in charge, the first annual report being presented in July, 1898, to the directors in London, Eng. The first year's receipts of the company were as follows: Victoria, $73,538; New Westminster, $60,947; Vancouver, $52,789.

In 1900 the receipts were $412,368. The capital was then increased in proportion to the increased returns. In 1902 the system of a bonus to employees was decided upon, the amount received by each employee in the first year being $18.20. In 1902 Mr. Glover commenced his connection with the company, which has continued till the present time.

Mr. Sperling was promoted to the position of general manager in 1905, after having worked himself up from a minor position in the eleven years of his service. The progress of the company from year to year was dealt with exhaustively by the lecturer who pointed out that although the concern had always been looked upon as a gold mine by those who did not know the situation, none of the original founders had become rich, and several had died poor through their faith in the future of electric transportation. Mr. Glover paid eloquent tribute to the memory of the pioneers who were not afraid to risk their all for the benefit of the city and province. The capital of the B. C. Electric Railway Company to-day is quoted at $45,000,000, the receipts for the year 1913 being $7,170,523, as against $903,014 in 1905. The number of passengers carried last year was 71,973,822. The business of the company has increased nine times during the nine years since 1904, and the expenses have increased to a corresponding extent.

Merritt Power and Water Plant

By Mr. N. M. Hall, Supervising Engineer

SOON after the incorporation of the city of Merritt, B.C., steps were taken by the new council to add to the rapidly growing city a much needed waterworks system, and at the same time an up-to-date electric plant to replace the small privately-owned system formerly in service. Messrs. DuCane, Dutcher & Company, consulting engineers, of Vancouver and Calgary, were commissioned by the city to look into the situation, and in June, 1912, were able to present a report favorable to the installation of a steam generating and pumping plant, and the necessary electric power and waterworks distributing systems. Generation by steam was recommended on account of the proximity to the extensive coal mines of the city from which fuel was obtainable at a reasonable cost. A gravity water system was not favored due to the excessive cost of pipe lines, but was reported on as a possible future undertaking. The source of water is the Coldwater river, a mountain stream of considerable size, and the pumps were to pump directly into the city system with an overflow tank on an adjacent hill to provide a head of about 25 feet. In July, 1912, the report was accepted, and the necessary money bylaws passed by the city.

The site chosen is on the east bank of the Coldwater River, about 300 feet from the stream. The choice was made in order that the water would be thoroughly filtered in percolating through the gravel bank to the pump well, which is located partly under the power house building. This well is approximately 6 x 10 x 13 ft. deep, and connects by two 8-in. pipes with another well 6 x 20 x 8 ft. deep, located towards the river. Both wells are sheet piled to prevent gravel falling in, and the outer one is arranged with close screens to permit of easy cleaning, see plan herewith.

The building, which is of reinforced concrete with wooden trusses supporting a corrugated iron roof, was erected by Fowler & Larsen, local contractors. An intermediate wall divides the boiler room from the engine and pump-room. In each end is a centrally located double sliding door, and in the boiler room on opposite sides are smaller doors, one near the stack for the removal of ashes, and the other for wheeling in coal from the adjacent coal tracks. A concrete floor in the engine room covers all except the entrance to the wiring and rheostat pit behind the switchboard.

The boilers, stack and feed pumps were supplied by the

Canada Foundry Company of Vancouver. The boilers are return tubular 72 in. x 18 ft. in one battery connected by a circular steel breeching to the 48 in. x 65 ft. steel stack just outside the building. The duplex feed pumps are for use in emergencies only, as the city water pressure will feed the boilers under ordinary conditions. The Griscom Spencer stage, 1750 r.p.m. Mather & Platt type and is driven by a Canadian General Electric Company 55 h.p., 2000 volt, wound motor. The secondary grids are located in the rheostat pit, and the controller is shown near and to the rear of the board.

The constant current transformer for the series street

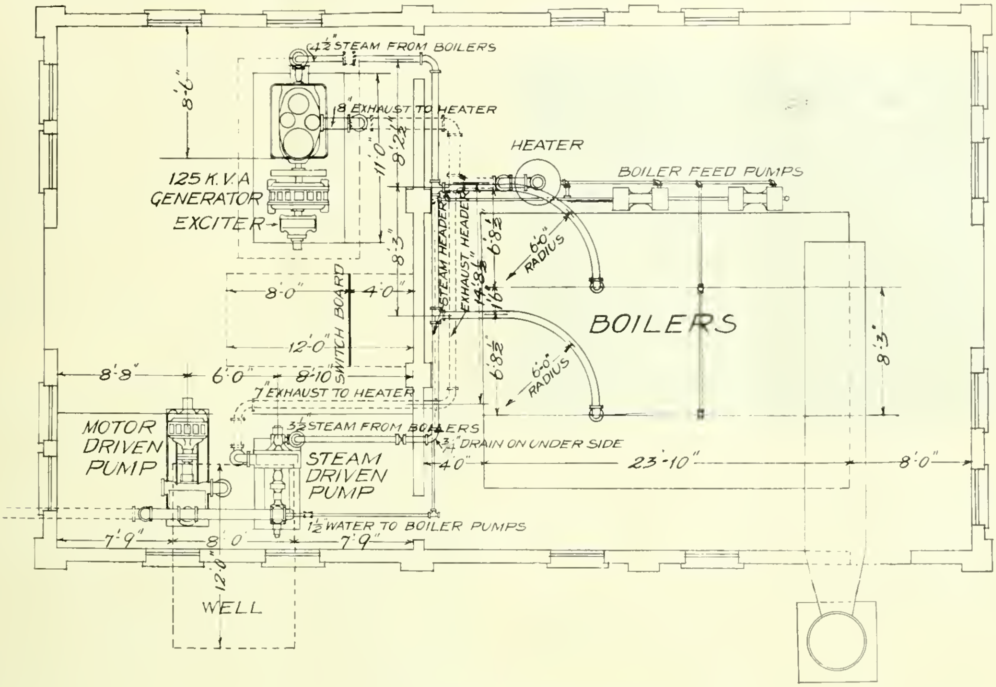


Fig. 1.—Plan of new steam-electric generating plant, Merritt, B.C.

closed feed water heater was supplied by the Chas. C. Moore Company, of Seattle. This type was chosen in preference to the open type on account of the little attention required due to the excellent quality of feed water.

The generator unit consists of a cross-compound, vertical, high-speed, Goldie-McCulloch non-condensing engine direct connected to a Canadian General Electric Company 125 kv.a., 2200 volt, 3-phase, 60 cycle unit, with direct connected exciter. The unit runs at 450 r.p.m., has forced lubrication and sensitive governor, and complete set of gauges and tachometer.

The switchboard and all wiring and conduit installation was supplied by the Canadian General Electric Company. The board, which is of blue Vermont marble, consists of one combined generator and exciter panel and three feeder panels. All wiring is in conduit and all lines lie under the floor, and extend up the wall to the outlet in lead cable in conduit.

The rheostat pit is under the switchboard and suspended from the ceiling are the instrument transformers. The pit is concrete lined and damp-proof. The pumps, which are each of 400 gallon per minute capacity, are located as shown in the accompanying plan, and directly over the suction well. Both were supplied and installed by the Canada Foundry Company. The single stage pump is driven by a Terry non-condensing steam turbine at 2100 r.p.m. and is intended for a standby in case of fire or emergency. The other is a two-

lighting circuit was supplied by the Canadian General Electric Company. Included is the control panel with plug switches and lightning arresters. The capacity is 10 kw. and it controls a 40-lamp, 7.5 ampere circuit. At present only one 3-phase circuit leaves the station, and the spare panels are used to control the motor-driven pump and the series circuit respectively. These connections are temporary only.

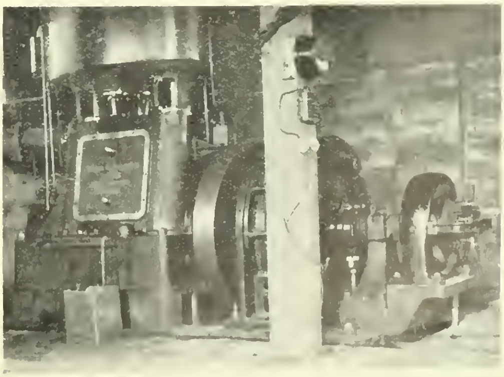


Fig. 2. Vertical, high speed engine-generator set.

as these panels can at any time be used for additional circuits.

The present overhead distribution consists of a 2200 volt, 3-phase circuit with 110 volt secondaries and a single phase, 2200 volt, series circuit, operating street lamps. The latter circuit is of No. 8 w.p. wire, while No. 6 and No. 8 w.p. are used on the three-phase and secondaries and arranged to give the best voltages. The transformers, including that

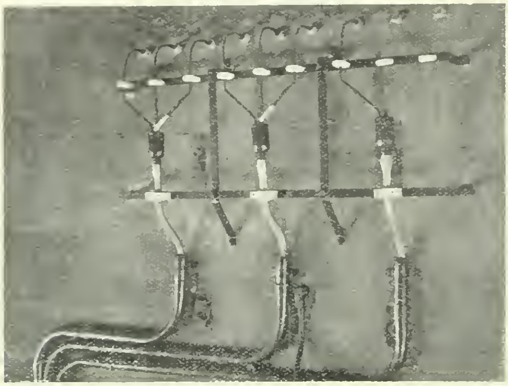


Fig. 3.—Outgoing power lines, Merritt, B.C.

for the station lighting, are the standard C.G.E. Co. pole type and protected by primary fuse plugs. The street lamps were supplied by the Canadian General Electric Company and are hung from No. 10 messenger wire spanning the street and isolated by two suitable strain insulators. The series lamps are 200 watt and 7.5 ampere.

The waterworks system consists of an 8-inch main leading from the pumps to the city system, and thence to the 50,000 gallon reservoir on the hill opposite. The city system consists of a network of 6 in. and 4 in. pipe, fully equipped with isolating valves and hydrants. All pipe used was steel, hub and spigot, and supplied by Robertson, Godson & Company, of Vancouver. The seventeen hydrants were all of the modern Ludlow type.

The wood stave tank was supplied by the Municipal Construction Company, Vancouver. A tell-tale visible from the power house indicates the water level. The overhead wiring was installed by A. B. Kennedy, local electrical contractor, and the machinery, switchboard and connections by the Canadian General Electric Company. The boiler installation and piping, as well as the waterworks system, were put in by day labor.

About March 10th, 1913, the power was turned on in the city, and about the same date the waterworks system was put into commission. A pressure was obtainable at each hydrant of 100 lbs. per square inch, which gives ample fire protection. The water filtering through the natural gravel bed is of good quality and quite free from sediment and scale-forming impurities. The plant, since being put into commission, has run practically without interruption and the city has a plant with ample capacity and reliability to meet the demands of the city and district for at least five years to come. The design and supervision of the work were in charge of DuCane, Dutcher & Company, consulting engineers, Vancouver and Calgary.

The Hydro-electric Power Commission of Ontario have advised the purchase of the plant of the Interurban Electric Company of West Toronto. The price mentioned is $280,-000.

Public Service and Public Opinion

By Mr. William McClellan*

Every business needs the support of public opinion. Where there is competition, the need is quickly perceived and the support is striven for. Merchants of commodities know another kind of competition, that of disuse. The overcoming of this type of competition they call "creating a market." This is our kind of competition, and we, the public utilities, need the support of public opinion to overcome it. It has taken most of us a long time to realize this, but, with a few exceptions, we recognize it now. Our obtuseness in the past, however, has left us with a sorry burden, for we do not simply lack the support of public opinion but find that that which does exist is adverse to our welfare. We are in the class which the community does not trust, along with the ice man and the watering milkman, and the short-weight coal man. How can we change our condition and get the support of public opinion?

When I consider our circumstances, I am not at all hopeless. I simply try to recognize a problem and then seek the solution. And the problem must be solved if the business is to become entirely satisfactory. Merely dodging an answer never removes a really vital question.

Distrust and consequent regulation did not arise out of vindictiveness. By forgetting or ignoring the force of public opinion, we brought it all upon ourselves. I prefer to think of the public not as wanting to "get us," not as consciously unfair, but as simply insisting on certain rights which have so frequently been denied it in the past. The public must deal with us, and if it prefers to deal through Commissions, there can be no reasonable objection on our part. Fortunately, there is little objection; and education with patience will remove whatever difficulties loom up great at the time.

How shall we gain the much needed support of public opinion? Naturally, it must be gained in such a way that we may keep it. It is the foundation of our business. Unless we build on it, the results may be very disastrous. There are examples enough now to show what is sure to happen in the way of repudiation, virtual confiscation, and even total loss, if public opinion is continually flaunted. There are also examples to prove that in times of stress public opinion is the inner line of fortification which secures a company against annihilation by political and other opportunists.

We may put this differently. Public opinion will support us only on the basis of an enduring confidence. It must have faith in us, which means we must keep faith with it. This involves a sincerity which is not merely a business policy but a state of being. For many of us, it means a complete change of mental attitude, a decided shift of position. Mere promise or protestation will not do. Every action, every statement, every interview, every contract, every negotiation, not only by the chiefs but also by every employee, must be based on a confidence-begetting sincerity. A simple slip, a single case of double-dealing, too much shrewdness, or one attempt to "put something over," can easily undermine a confidence which has been built up by years of effort and thousands of dollars of expense. How shall we start? What are some of the cardinal points?

In the first place, if we have not already done so, we must clean house. We cannot be sincere if we have anything to hide. We ought to know how much property we have, and what it is worth on some basis. We ought to know the cost of doing business, and whether it is as low as our circumstances will permit. We ought to know the condition of our property, and whether it is being handled so as to be continuously in a state of 100 per cent. operating efficiency. We know better than anyone else that rate-making is not a matter of scientific accuracy; but, nevertheless, it should not be

*Consulting Engineer, New York.

a matter of grape-vine growth. We ought, therefore, to make sure that each particular group of rates is internally consistent on some basis. We ought to be able to give some explanation of their peculiar forms. If we are accumulating various funds and accounts, we ought to be able to give an adequate reason for them. We ought to know just what profit we are making, and whether we could square this with public opinion. We have no business to be criminally prosperous.

Such a house-cleaning will be dictated by enlightened self-interest. Public regulation ought not to be able to do more than we can do ourselves. In a few cases, it is demagogic; usually, it is prompted by honest intentions but is accomplished in an ignorant and inexperienced manner. Unfortunately, in the past, it has been too frequently found, on the examination of many companies, to be a mess of greater ignorance and planless operation. Information was not available until it was dug out by the regulators. After many a regulation, in spite of some unpalatable orders perhaps, the company has hardly recognized itself in the light of the information given to it by the investigation. Moreover, there are not many examples of ruin caused by regulation.

Provide a Better Plan

Having cleaned house, and with nothing to hide, we ought to be accessible. The prepared-food people have shown us the way. They cleaned house, and then invited the public to come and see how clean it was. Their business is something like ours. Both of us are in a business which the public can do for itself, if it wants to, though in different ways. As a matter of fact, the public went into business with us when it gave us a franchise. We thought it was a free gift, but we were somewhat blind and misled. Again enlightened self-interest would want the public to be acquainted with us. Our officers, therefore, high and low, should be easily accessible. Offices should be arranged so that there is an atmosphere of ease and welcome. The limit of authority of under officials and employees to make adjustments in accordance with well-established principles should be set as wide as possible. Information and explanation should be given with great freedom. The public has the right to understand the basis on which it is paying for service, and it is to our interest that they should. It is easy for a merchant who has one price for a particular article to get the confidence of his patrons. It will be just as easy for us, if we can make our customers understand that we really have one price for each particular kind of service.

Proper relations with, and fair treatment of, our employees are powerful aids to the good-will of the public. It is often forgotten that employees are part of the public, that they live in all sections of our territory, that they are frequently asked questions about this and that feature of our often perplexing methods; and that, therefore, they have much opportunity to mold public opinion. The sincerity of the company can be impressed on them in several ways, not with the idea of buying their loyalty and good-will but of inducing these valuable assets. They should never be asked to do anything which could not be justified publicly if necessary. They should understand that nothing is going on in any part of the company that need be concealed, and that their own work is to be carried on in the same manner. They should be taught the ideals of the company, and that they are expected to have a large part in the realization of these ideals. All questions of hours, remuneration, and other working conditions should be open for discussion at any time between the persons involved. Whatever the outcome, it should be capable of explanation from the standpoint of the business as a whole. They should be dignified by being treated as freely contracting parties with the company, and not as a species of valuable beast of burden which must be controlled and cared for. A certain amount of welfare work is desirable, insofar as it does not replace a proper increase in remuneration. This question of the employee has received too much attention of one kind and not enough of the right kind. They are our outposts in the public and have tremendous force in specific cases and in general influence.

A constructive policy in relation to social and community progress is essential in gaining public opinion. I believe that a public service company is the most important factor in the development of a community. To believe this and act accordingly is to realize the responsibility of our franchises. Have you ever thought about this "free gift" of franchises? The community wanted to give them to us and hoped that we would take them. They thought that we were going to make a lot of money through them; but that was not the reason that we got them. The community also expected to benefit greatly from the gift. Therefore, in proportion as it benefits, so will we gain their good opinion. This means adequate and satisfactory service, and extension of lines promptly so as to aid the growth of the community in area and development. Under such a policy, I believe rates will adjust themselves on account of the enlightened self-interest of the company. High rates and largest profits seldom go together.

This constructive policy will show itself in some broader phases of community life. Legislation of various kinds will not be opposed unless it is inherently wrong. When opposition is necessary, it will be done publicly; and in the hope of enlisting the intelligent sympathy of the community. The company, regarding itself as a good citizen, will be in active sympathy with all uplift movements, such as hospitals, and safety plans for the public and its employees. It will contribute from its funds, but especially by its knowledge and intelligent effort, so far as sound business and social policy will permit. The presentation of a pulmotor to a hospital, or of expenses to an injured employee are good actions in themselves. How they will affect public opinion depends upon whether or not the actions flow from a consistent business policy.

Be Accessible to the Public

In our own state, perhaps the most shining example of a lack of constructive policy is shown by our treatment of the conservation of water power. Public opinion regards the water powers of the state as great and valuable resources. Attempts are made to develop these resources and the public service companies of the state are found in opposition. There is some indication that this opposition is organized in the sense that it proceeds from national and state committees representing the companies. In the resentment which is called forth, it is not perceived by public opinion that the opposition is almost entirely against the method and not against the principle. This must be charged, however, to the lack of constructive effort on our part. Surely as business men, we know that the easiest method to beat a bad scheme is to provide a good one. In times past, when public opinion was quite inattentive to such matters, other methods were available, but not now. Opposition to such projects as these has a far reaching influence in our local business relations. Why should not the public service men of this state stand out in the broad light and acknowledge that the state has valuable water powers which could be developed? Why should these men not offer their wide experience in devising proper plans by which the developments could be made so as to give the state as a whole the benefits and profits to which it is justly entitled, and, at the same time, protect investments of all kinds already made? Why should not a bill be offered which the public service men could work for openly, in the light of day? I know that there would be much misunderstanding by the public. They have never been accustomed to seeing us play such a part. But, if it is right, we ought

to have the courage to attempt it. A dozen public service men, known in as many communities as men of probity, ability and experience, standing as directors of a campaign of education, going directly to the public of their own communities, hiding nothing, using no subterfuges, might have a long pull to the finish, but would discount failure at the start. And the collateral benefits from such a campaign would be very great. Public opinion is now active and thinking about our affairs. We must reckon with it; or, finally, lose out.

Advertising, I have put last where I think it should be. After we have done everything else which is necessary, we can talk about it. I believe in advertising and plenty of it. This is not the place to discuss methods, where there are so many. As a matter of fact, everything that we do should be advertising, that is, turning the people to us. Advertising which is mere protestation or exaggerated promise is ruinous, in the end; and is likely to result in nothing but a cynical smile. Simplicity, truthfulness, and sincerity count here as elsewhere.

After all, does not our whole argument mean that we must take the public into a real partnership? In a peculiar sense, they have been contributors to our enterprise. A franchise is a necessity in order to have a public service business and yet there has been little disposition to allow a company to value it. May this not be regarded as the equity of the public in the business? Are not all the attempts made by the public to regulate our business to be regarded as an attempt to assert this partnership? May it not be that its very obstinacy arises from our past stubbornness in regarding our business as entirely private, to be operated as we saw it. The total disregard by the public, in the past, of its interest in our business is as much responsible for the present condition as our misunderstanding of the relations which should exist. While the change is taking place, there is great danger that the dominance of capital will be exchanged for the dominance of the public. Both are bad, because they are both naturally self-seeking. The hope of a proper balance is in the operating man, from President to common laborer. His part is to teach each of his partners to respect the rights of the other. The "Company" can no longer be synonymous with "Capital" but must mean the three-strand partnership of capital, labor and the public.

Hamilton Section C. E. A.

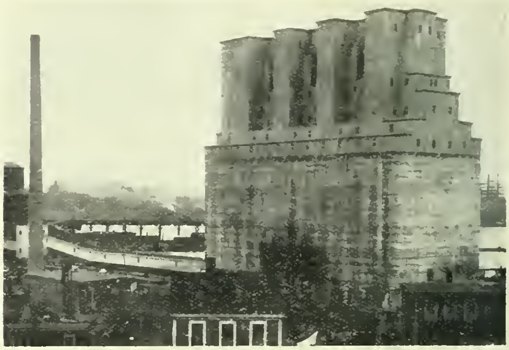
The Hamilton section of the Canadian Electrical Association held its February meeting on the evening of Thursday, February 26, with a large attendance of members. The special feature of the evening was a lecture on "The Ozark Water & Power Company's Development on the White River," written by Mr. T. O. Kennedy and presented by Mr. N. S. Cumming. The lighter side of the programme consisted of a number of musical items and an interesting travel talk by Mr. Coleman, general manager of the Dominion Power & Transmission Company, consisting of a description of a fishing trip in the north country. Mr. J. H. Larmonth, secretary-treasurer of the Canadian Electrical Association was present and addressed the meeting on association work.

Provision is made in this year's expenditure on the Montreal harbour for the electrification of the railway system. The cost is put at $282,674, with $300,000 for equipment. This year the electrification will be pushed as far as possible, and the actual trackage extended to Pointe aux Trembles. The ultimate terminus of the railway system is Bout de l'Ile, which it is expected will be reached next year. On the south shore, where the commissioners will carry out extensive improvements, eight miles of electric railway will be laid down.

C. P. R. New Terminal Elevator

When navigation closes on the St. Lawrence river in the fall, the railways have to haul grain for winter export to one of the winter ports, where cold weather cannot stop the necessary work. The new terminal elevator shown in the accompanying illustration has just been completed and put into operation at West St. John, N.B., the winter port of the Canadian Pacific Railway.

The elevator is 92 ft. 7 in. wide by 195 ft. 7 in. long and the roof of the cupola is 202 feet above the tracks in the elevator first storey. The bins are of reinforced concrete resting on a heavy girder and slab foundation of the same material. The principal bins, of which there are 77, are circular or elliptical in shape and are 84 feet deep averaging a capacity of 11,000 bushels each. The 94 resulting or interspace bins hold an average of 2,000 bushels each. This makes 171 bins, with a total figured capacity of 1,035,000 bushels. The cupola is built of structural steel and is 93 feet high, comprising five storeys for weighing and distributing grain. The steel frame is covered with galvanized corrugated iron. Floors and roofs are reinforced concrete; roofing is 5-ply



New C.P.R. elevator—Power house seen to left.

Barrett specification tarred felt and gravel; windows are wire glass.

Electrical energy is used throughout; elevator legs, separators, dust collectors, conveyors, passenger elevator, car puller and car shovels being driven by individual motors. There are four tracks running lengthwise through the elevator, serving eight elevator legs of 12,000 bushels hourly capacity each, all of which are driven by individual 75 h.p. motors. Rope drives are used, and a clutch on the countershaft enables the motor to start without load. The elevator legs deliver grain to eight 2,000 bushel garners, below which are eight 2,000 bushel hopper scales. From these scales the grain is distributed to the bins, two motor driven conveyors on the floor beneath the scales giving great flexibility to the system of distribution. By installing reversing switches on the motor leads, these conveyors may be run in either direction. Although this elevator is not specially a grain cleaning house, it is provided with two large separators, driven by individual 15 h.p. motors, to handle such work as may prove necessary. The passenger elevator is driven by a squirrel cage induction motor. It is considered inadvisable to use any other type of motor for grain handling as the smallest electrical spark is sufficient to set fire to the grain dust, which penetrates to all parts of the elevator.

On the ground floor a 75 h.p. motor operates two car pullers, by rope drives. Each car puller has two winding

drums with heavy steel cable, designed to move fifteen to twenty loaded cars. The car shovels are operated from two line shafts, each driven by a 35 h.p. motor. It is anticipated that the time will come when most of the grain will be carried in cars so constructed that the entire load may be dropped into the hopper below the track without the use of car shovels.

For shipping grain, there are two 36-in. conveyors loading through an elevated gallery to the old C. P. R. elevators and thence to all the vessel berths on the Sand Point Basin.

The power house is a brick building 38 ft. wide by 80 ft. long and 25 ft. high. The equipment consists of four horizontal return tubular boilers 72 in. x 16 ft., carrying a working steam pressure of 150 pounds; two Allis-Chalmers turbo-generators of 500 kw. each, operating in connection with a Worthington barometric condenser; a 10 kw. lighting set, together with feed water heater, pumps, etc. The smoke stack is of reinforced concrete, 6 ft. inside diameter by 202 ft. high, see figure herewith.

The turbines run at 3600 r.p.m. and generate 3-phase, 60-cycle, 550-volt current, which is fed directly to the motors. A motor driven vertical, centrifugal pump supplies sea water for condensing purposes through over 1000 feet of piping. Under ordinary conditions lighting current will be supplied from a 550/110 volt transformer; as an alternative or when the turbines are not running, the lighting set may be used. The switchboard is so arranged that the two generators may be operated in parallel; and the two exciters, which are mounted on extensions of the generator shafts, may also be paralleled on direct current bus-bars. A Tirril regulator maintains constant voltage on the main bus-bars at all times.

The wiring from the power house to the elevator is carried overhead in a single span about 30 feet clear of the tracks, and supported from steel frameworks on the power house roof and on the walls of the elevator. Throughout the elevator and power house all wiring is installed in conduit. The conduit is fastened rigidly to the concrete walls. Heavy iron straps and expansion bolts are used to prevent any possibility of the conduit becoming loosened, due to corrosion, and to make the installation as permanent as possible. Feeders are run to the different floors where power panels, with branch fused circuits for the individual motors, are installed.

The motors are fused for about 250 per cent. of their rated capacity; amply large to allow for starting up, even under load. Motors are installed with liberal power for the work to be performed and to meet all overload demands. The fuses are not designed to, and indeed do not, protect the motors against overload, but merely operate in case of an accident. The importance of avoiding a shut-down is responsible for this method of fusing. Motors protected thus have been used extensively for grain handling, and where properly designed and proportioned for the load, give thorough satisfaction.

An intercommunicating telephone system connects the various floors and offices in the elevator and with the power house. The telephone cable is lead covered and installed in conduit, experience showing that this is the only satisfactory method of installation. Electric signals are used to facilitate handling grain inside the house and for the passenger elevator.

Throughout, the electrical work is of exceptional ruggedness of design, and this applies to motors and panel boxes, as well as to the wiring. Dust, dampness and the importance of maintaining continuity of service, all combine to bring about problems which can only be solved by using apparatus with more than the ordinary factor of safety.

The turbo generators were furnished by the Allis-Chalmers Manufacturing Company, of Milwaukee; induction motors by the Canadian General Electric Company, and the Canadian Allis-Chalmers, Limited. The Northern Electric & Manufacturing Company supplied the switchboard. The electrical installation, including all wiring and erecting the switchboard was carried out by W. J. O'Leary & Company, of Montreal. The constructing engineers of the entire plant were the John S. Metcalf Company, Limited, of Montreal and Chicago, acting under the direction of J. M. R. Fairbairn, assistant chief engineer of the Canadian Pacific Railway Company.

Personal

Mr. W. T. Woodroofe, superintendent for the past two years of the municipal street railway system of Edmonton, Alta., has resigned.

M. Thomas Ahearn and Mr. James D. Fraser, president and secretary-treasurer respectively of the Ottawa Electric Railway are spending a few weeks' holiday in Florida.

Mr. P. T. Davies, of the Montreal Light, Heat and Power Company, has been appointed alternate statesman for the Province of Quebec of the Jovian Order. The Montreal members are holding a weekly series of dinners, lectures, and entertainments at the Commercial Travellers' Club.

Mr. Frank Ahearn, a director of the Ottawa Electric Railway, and son of Mr. Thomas Ahearn, president of the O. E. R., has been approached by a number of his friends to accept the liberal nomination for West Ottawa and contest it with Mr. J. A. Ellis, M.L.A., in the next provincial election. Mr. Ahearn says he is not yet prepared to say whether he will yield to the importunities of his friends in the matter. Mr. Ahearn, with his wife, is now spending a two months' vacation in Europe.

Mr. J. H. Larmonth.

Mr. J. H. Larmonth has been appointed manager of the Edmonton Municipal Electric Railway System, succeeding Mr. W. T. Woodroofe, resigned. Mr. Larmonth has had a varied and valuable experience in electric and electric railway work. For many years he was manager of the Peterborough Radial Railway Company during the construction period of this company. Later he was also manager of the Peterborough Light & Power Company. When these two companies were taken over by the larger Electric Power Company, Mr. Larmonth became general manager of the latter. Some two years ago he resigned this position to take up private consulting work in Toronto, and a few months ago he was induced to accept the secretaryship of the Canadian Electrical Association, which latter position he has held up to the present time. Mr. Larmonth therefore brings to his new work an experience which augurs well for the success of the western city's railway system.

Will Manufacture Steel Lamp Posts

The Canadian Union Metal Manufacturing Company, recently incorporated, have commenced manufacturing pressed steel posts, etc., in the Edwards foundry at Galt, Ont. The company will build a new factory 60 ft. x 300 ft., one floor, during the present year. When completed the factory will turn out all sorts of pressed steel columns for verandahs, interiors, etc., including lighting standards for street work.

Organization of a Stores Department

An article dealing with its organization, management and records, also showing some of the forms used by the Toronto Electric Light Company, and storage shelving and racks of Buick Motor Company, of Boston, Mass., and Union Street Railway Company, New Bedford, Mass.

By Mr. W. G. Astle, Storekeeper Toronto Electric Light Company

The Stores or Stock Department of any business is that section which has the custody of its stock-in-trade, materials, supplies, and other physical property, except real estate. This department when scientifically organized and managed becomes one of the most valuable from a profit-making standpoint, but, without the proper organization and management it may degenerate into one of the most useless. The organization and system must be of the very best to attain the state of efficiency of which it is capable, and like every other department of a business, the organization depends largely upon the nature of the business.

What is Material?

Material is the first great factor in the cost of a thing to the producer, and may be classified as Raw Material, Finished Commodity, and Accessory Material.

Raw Material may be defined as any material for use in process before it has been subjected to that process. Finished Commodity designates any industrial product which is introduced, without substantial charge, into the composition of another product, usually as an accessory part. Accessary Material is material necessary to a process, yet not actually entering into the completed product, and is commonly considered a part of general manufacturing expense, particularly if the material is used again and again, and not directly chargeable against any one particular job.

Two Types of Organization

The aim of any organization should be: To systematically unite each individual into a body purposed to work together for one common end; to unite in reciprocal and concrete relation and duties; and, to bring into systematic connection and co-operation parts of a whole. This is the first necessity of any organization, either commercial or industrial.

The elements of any organization are men, equipment, and space. You have an efficient organization when the elements are combined in such a manner that they will operate harmoniously, accurately and promptly, and will achieve the result required with the least expenditure of money and effort.

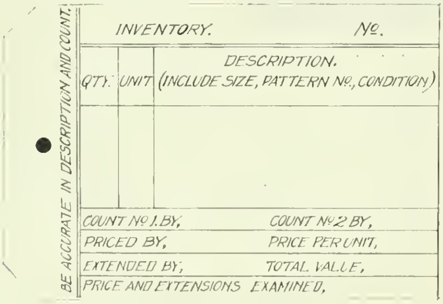


Fig. 1—Inventory cards.

Organization can be divided into two kinds, military and functional.

Functional organization is a type of organization that gives each worker, whether executive or clerk, as few functions as possible to perform. Major Charles De Lano Hine, in his book "Modern Organization," describes the unit system of organization employed on the Union Pacific Railway, which is a type of functional organization peculiarly adaptable to the railway business by reason of its scattered forces.

Military organization is a type of organization where one man has supreme authority over a branch of the company's work. Mr. F. W. Taylor, in his book "Shop Management," points out that this type of organization is inefficient, because if the man's duties were properly fulfilled, he would actually be an expert in many branches of business knowledge. The foreman who hires and fires, plans the work, supervises the cost accounting system and has charge of new construction, operates under this plan.

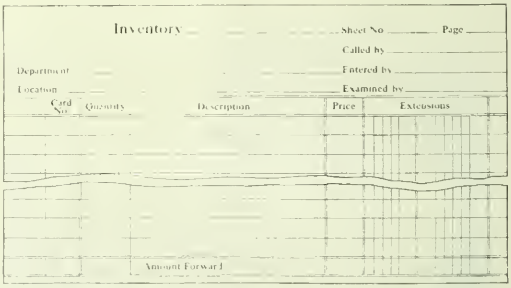


Fig. 2—Inventory record taken from cards, Fig. 1.

The organization of a storeroom, however, will have to be modeled according to the conditions found in the individual establishment.

Scientific Management as Applied to a Storeroom

Scientific management has passed the stage of experiment and has firmly established itself in many of the greatest industries. Men have been slow to grasp the significance and tremendous possibilities of the scientific means of doing work in all branches, but the survival for over thirty years of a movement of this character through all the opposition, objections and difficulty strewn in the path of any innovation gives trustworthy evidence of the soundness of the ideas and a fair prophecy of their extensive application in the near future.

The physical aspects of a storeroom under this style of management do not differ very much from any well systematized storeroom. A proper means of storing and piling the material, laid out in an orderly fashion should be provided. To avoid confusion in a varied terminology, monomeaning symbols should be used to designate the different kinds of material. The maximum and minimum should be determined for each kind and kept on the stock ledger sheets or cards. The location of the materials should also be indicated on these sheets or cards.

Under this style of management it is not enough, when material is required, to send a requisition to the Stores Department, but all orders for work that require material

should have the items booked up and assigned to the specific orders by the Storekeeper, and this material, when assigned to a given order, should not be available for any other orders whish may follow. This should be done before the material is required for use and will serve as an advance notice to the Storekeeper should any unexpected demand for a particular material occur.

The work of moving materials into the storeroom and moving them to the particular place where they are to be used, becomes a function of the planning of the work, and of the routing of the work, and the man who is to use them should not be delayed or have to give a thought to the materials which he needs for his next job. They should be moved in the right condition for his use to the point where he can use them to best advantage. The time which the man spends looking or waiting for his material can be better spent in effective work.

Fig. 3—Storage adjustable shelving.

Inventories

Before a system of stock records can be successfully installed, a complete inventory must be taken, and from this is formed the basis on which the records are founded. When once this inventory is taken and properly recorded, it is possible to install and maintain a system which will make it unnecessary to take an inventory of all the materials at any one time. The chief requirements of an inventory are exactness in description, enumeration, and appraisal.

Several gangs of men working together in different parts of a storeroom make it impracticable to take a consecutive list of the materials on hand, therefore it appears best to make the original records on cards, one for each lot of similar items. These cards, Fig. 1, should be numbered consecutively, and should be provided with a hole punched at the centre near the top, for attaching a string, as with the ordinary shipping tags.

Before beginning an inventory all the men should be called together and given instructions in the methods to be followed, and foremen should be selected for the various gangs and assigned to the materials with which they are the most familiar. They should also be instructed to commence at a suitable point and progress regularly. The foreman of each gang will then record the data for each lot on the cards, and check the count of his helpers, after which he will attach the card to the material. This procedure is followed until every different article in the storeroom is tagged. This is only a preliminary count and the work in the storeroom should not be interrupted to any great extent. The man who takes out any material should change the tally memorandum on the card for any lot of material already counted.

On the date decided upon for the inventory, the work should be changed around so that a different force of men will go over the work done by the gangs in the first round. This second gang will take off the cards attached to each lot, verify the condition and number, and proceed as rapidly as possible. It should not be necessary for this second gang to check every piece of material, but only to test occasional places at random, or to satisfy themselves in some way that the cards give an accurate record of the material they represent. When these cards are all checked and removed, they should then be sorted numerically to make certain that they are all accounted for, after which they can be arranged in any way that will simplify the operation of pricing. After they have all been priced, checked, and arranged in whatever way desired, the inventory can then be typewritten on loose-leaf sheets, Fig. 2, and bound for future reference.

Perpetual Inventory Plan

The old custom of making inventories but once a year is fast becoming obsolete, due to the fact that under that system little opportunity is given to trace losses in any department, and to the difficulty of going over the entire amount on hand at any one time. A better arrangement, and one which commends itself to the practice of to-day is commonly called a perpetual inventory. To adopt such a plan, it must be first ascertained the number of kinds of material in stock, and a schedule arranged whereby a certain number of items are counted each day during the year, and compared with the stock sheets or cards; if necessary they should be immediately readjusted. The result of this method will be that no extra effort will be required, and the work can be done by the storeroom staff, who are thoroughly familiar with the different materials handled almost daily in filling orders.

There is no real reason why an actual inventory should be required at any one time. If the Storekeeper has a check, from time to time, of the actual stock on hand to compare with his stock records, it is just as practical as though all his information was supplied to him at one time. On the other hand, this plan has many advantages in that it does not interfere with the routine filling of orders, it does not require the employment of additional help in the storeroom who are not familiar with the material in stock. In actual operation, the above plan is not only feasible, but it has proved most desirable from an efficiency and economy standpoint.

Fig. 4—Storage adjustable shelving.

Storage, Shelving and Racks

This is one of the most important points to be dealt with when installing an up-to-date storeroom system, and very often there is not enough importance attached to this feature

Unit Foot. Price 1750/M. Description Backing 4" — Location: Floor 1st Section E Shelf 1 — Normal Stock 800 Minimum 300

Date		Ordered Quan.	Req. No.	Purch. No.	From	Received	Disbursements	Balance	Verified By
								1100	
June	10						240	860	
"	11						20	840	
"	13						6 6 10 2	816	
"	14						20	796	
"	17						4 20	772	
"	18						6 6	760	
"	19						4 6 10 12	728	
"	20						6 6 10 6	700	
"	21						8 10 6	676	
"	23						4	672	
"	25						12	660	
"	26						20 8 9	623	
"	27						20	603	
"	28						10 10	583	
	30						3 6 10	564	OK.A
July	2						12 12 15	525	
"	3						12 12 6 12 4	479	
"	4	500 ft	13395		Scholey Bros.		12 10 6 12 18	421	
"	8						15 20	386	
"	9			13395	Scholey Bros.	500	10	876	
"	11						4 12 12 10 6	832	
"	12						12 10	810	
"	14						6 10 6 10 22	756	
"	15						10	746	
"	16						12 6 6	722	
"	17						6 12	704	
"	18						10 10	684	
	19				Returned		[illegible] 5 10 (Red Ink)	764	
"	21						6 24 16 10 10 6 12	680	
"	22						48	632	
"	23						15 12 10	595	
Totals						500	573 228 132 74 60 6 12 = 1085 − 80 returned = 1005	595	OK.A

Fig. 5 – Stock ledger sheets, showing only units.

of storeroom facility. In quarters which are crowded, and have not the proper kind of storage bins and shelving, confusion will invariably result. When materials are crowded into a storeroom on improper racks, or shelving, the difficulty of keeping track of the materials needed is increased. Materials will be ordered when a sufficient quantity is already on hand, but cannot be located; or some special line will be overlooked entirely until the last moment, when it is required. This item of storage is deserving of more than passing notice, for thousands of dollars will be spent, and maybe wasted, if great care is not exercised in keeping the supply of materials up to the requirements.

Nearly everyone will agree with the writer, that the advantages of steel racks and adjustable shelving over wooden equipment are very great. In the opinion of the writer, the best steel equipment for storeroom racks and shelving on the market at the present time, is the "Lyon," Figs. 3 and 4, which are manufactured in Aurora, Illinois, by the Lyon Metallic Manufacturing Company. The main features in the "Lyon" racks, are their strength, simplicity, and adaptability, they are fireproof, permanent and occupy much smaller space than the wooden equipment. They are made in standard sizes and one or more sections are complete in themselves, which enables you to gradually increase your storing facilities as business demands, or they can be taken down at any time and assembled in another position.

Each section of bins or racks should be given a letter and each individual bin or shelf a number, so as to enable the location of the materials to be specified on the stock records.

The question of what is a proper storage place and the laying out of the floor space is one which must be worked out to fit the conditions as found in the individual establishment. In a manufacturing business the materials should be located as near as possible to the departments in which they are used. In the larger plants it is sometimes necessary to have several storerooms to accommodate the various classes of material, and in order that they may be located conveniently. The question of proper storage is a vitally important one in every business, and especially so in a manufacturing plant. Ideal conditions are impossible to obtain in all plants, but the very first consideration should be to have a definite place for every class of material, and always keep the class in that one place. The question of the size and weight of the material, and the frequency with which it will be needed, should be the first consideration. Extremely heavy articles should not be stored on the floor, but should be raised to about the height of a truck, which will save labor in loading and unloading. Material which is constantly called for should be kept on shelves within easy reach. The top shelves and inaccessible corners should be reserved for the articles which are seldom called for. As far as possible, all material of the same class should be kept in the same location or section of the storeroom. Above all, a given article should always be kept in the same place.

The Storekeeper and His Duties

The Storekeeper, under the direction of the Purchasing Agent, or in some plants he should be under the Superintendent, should have full charge and authority in the Stores Department. He should have charge of all assistants and storeroom clerks, and must render receipts to the Accounting Department for the entire intake and output of all material and supplies. All requisitions for material and supplies should be made by him, to the Purchasing Agent, and in

some cases the requisition should be accompanied by a record of the material on hand at the time of requisition. He should be solely responsible for the maintenance of a perpetual stores inventory system, and for keeping it posted up-to-date. A Storekeeper must, above all things, be exacting, and have such complete control over the men in his employ that the slightest infraction of rules will mean the equivalent to a final check. He should be a man exceptionally well qualified for the position, capable and conscientious—a man who will appreciate the value of the material he handles and be fully alive to the responsibility of protecting the company's property to the letter. He should be familiar with the materials, and know their uses, but it is not necessary that he should be a skilled mechanic. On the other hand, he should not be simply a bookkeeper, or he may be unable to suggest uses for certain material, and, as a result, a lot of dead stock will accumulate, much of which might be employed for some purpose if brought to the attention of the proper parties.

Aside from the storeroom proper, the Storekeeper should have charge of all material which is stored outside. Lumber, fuel, and heavy castings are examples of material which comes under this head, and his records should include all of this material, and he should have general supervision over its storage in order that he may more readily determine quantities in stock.

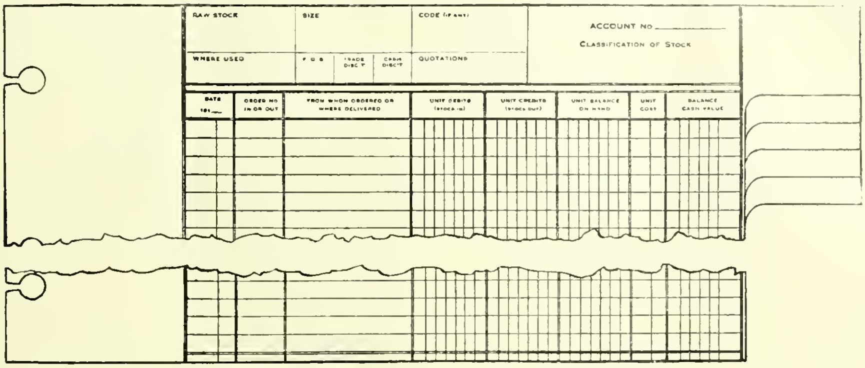


Fig. 6—Stock ledger sheets, showing both units and values.

LOW STOCK REPORT.

Mr.........................Storekeeper. Date................

The following items have reached the low limit.

.... Inventory Clerk.

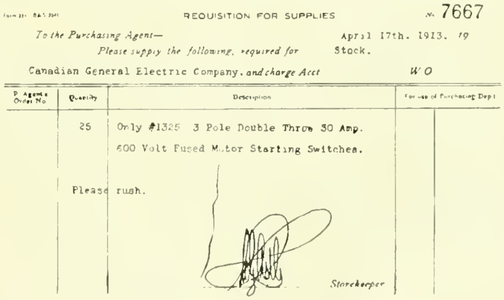
Low Limit.	On hand.	Material.	Remarks.

Fig. 7—Low stock report.

Stock Records

The purpose of a stock record system is to account properly for all material purchased and used; but the location of the storeroom, its relation to the departments served, and the ability and experience of the Storekeeper, may necessitate certain changes in details to meet local conditions. A theoretical system may be outlined which will afford a perfect record, but, when put into practice, it may prove unsatisfactory, or it may be too expensive for the protection afforded. A practical test is always advisable before a decision is made upon a stock record system for any business. The installation of a stock record system calls for the exercise of judgment of the highest order, for the record of stock, material or supplies is of no less importance than the record of cash, and should be accounted for with the same fidelity as cash, a dollar's worth of material should be regarded as a dollar in gold.

Stock sheets, Figs. 5 and 6, or cards filled topically (or numerically if a symbol system is used) should be kept for each article in stock, and should show the unit, full description, location in the storeroom, normal stock and minimum stock; date, requisition number and quantity ordered; purchase number and name of the firm from whom purchased, dates and quantities received, and the dates and quantities given out, from which a record every day can be obtained of the quantities on hand and quantities on order.


REQUISITION FOR SUPPLIES No. 7667

To the Purchasing Agent— April 17th. 1913. *19*

Please supply the following, required for Stock.

Canadian General Electric Company. *and charge Acct* *W O*

P. Agent's Order No	Quantity	Description	For use of Purchasing Dep't
	25	Only #1325 3 Pole Double Throw 30 Amp. 600 Volt Fused Motor Starting Switches.	
	Please rush.		

Storekeeper

Fig. 8—Requisition from storekeeper.

Low stock report forms should be kept in the bins so that the stock clerk removing material is automatically notified that more should be ordered when the minimum quantity is reached.

Ordering Material for Stock

Every article of material should be given a low limit, and when this limit is reached, the stock record clerks should make out a Low Stock Report, Fig. 7, to the Storekeeper. This in turn should be verified by the storeroom foreman, and is recognized as a notice to order more. The report should show the low limit and the quantity in stock. The low limit should always be given, for in some instances it is found advisable to change the limit. Material formerly used in large quantities may be found to be in so little demand that it will be necessary to reduce the limit. At other times

it might be found advisable to increase the limit. Before replenishing his supply of any material, the Storekeeper should consult the head of the department using the material to determine if any changes in the specification will be made. Failure to do this sometimes causes the storeroom to become overstocked with obsolete material or material that has become useless on account of changes in standards adopted. When obsolete material accumulates, it should be sold, as it seldom improves with age.

THE TORONTO ELECTRIC LIGHT CO., Limited. Toronto, Can.

Storekeeper's Copy

Order No. A 11437

To The Benjamin Electric Co.
City

TORONTO ELECTRIC LIGHT CO. LIMITED APR - 1 1913 PURCHASING AGENT'S OFFICE

Please Ship to Carlaw... Plant.
Material as specified below
Via
Within Days

QUANTITY	DESCRIPTION	
12	# T 101 Benjamin Fixtures complete with globes	4/2/13
12	Extra globes for above fixtures	

W G Aster

Fig. 9—Storekeeper's copy of purchase order.

All orders for material should be made on a requisition form similar to the one shown in the illustration, Fig. 8. These requisitions should be made in duplicate, one copy being forwarded to the Purchasing Agent, the duplicate being retained by the Storekeeper, and held for the Storekeeper's copy of the purchase order, Fig. 9, after which they should be filed away under the name of the firm with whom the order is placed, to await deliveries.

Receiving Material Into the Storeroom

The Receiving Clerk should have charge of all materials received in the storeroom; he should unpack, make proper preservation of packing material and lumber for future use, check over entire receipt in detail. Under no circumstances should the consignor's invoice be given to the Receiving Clerk to check form, as this too often leads to check marks on the invoice without a count of the material. His memorandum of receipt, Fig. 10, should contain an account of all items and statements, and should be compared with consignor's invoice in the main office entirely independent of him. This method insures absolute certainty regarding the correctness of the amount and quality of the materials received.

THE TORONTO ELECTRIC LIGHT COMPANY, Limited 191

Order No. A

Goods received by Stores Department

From

Bags *Bundles* *Reels* *Via*

Barrels *Coils* *Charges*

Boxes *Crates*

Weight *Car No.* *Way Bill*

QUANTITY	DESCRIPTION	HOW USED

IMPORTANT
Full details of all Shipments received must be given above, and this form sent to Audit Dept. within 24 hours after receipt of goods.

Received by

Correct Storekeeper

Fig. 10 Receiving report—Storekeeper to auditor's dep't

After each order has been completed, all papers, from the requisition to the receiving report, which pertain to the order, should be collected, fastened together, and filed away under the order number, while a record should be kept of all order numbers showing the names of the firms on whom the orders were placed.

Date 191 | Work Order Number
To the Storekeeper | Account Number
Please furnish following material and charge to | Name
Address

QUANTITY	MATERIAL	PRICE	EXTENSION	
				Extensions
				Checked by
				Entered in
				L.
				FORWARD
				THIS
				TO OFFICE
Foreman on Job	Signed by	Total		

Fig. 11—Requisition form, when material is withdrawn.

Disbursements of Material

No material should be drawn from the storeroom except on a requisition properly signed and approved by the foremen of the different departments, and all material issued and not used should be returned to the storeroom and the proper credit given. Requisitions, Fig. 11, on which material is given out, should show the use to which it will be put, and the name of the operating expense or other account chargeable. They should all be numbered consecutively, the original being sent to the Accounting Department, and the duplicate retained by the Storekeeper for making the necessary records on the stock records, after which they should be filed under the account chargeable. Materials returned to the storeroom should be accompanied by a credit slip, Fig. 12. This form should go through the same routine as the requisitions or charge slips.

Date 191 | Work Order Number
To the Storekeeper | Account Number
Please receive the following material and credit to | Name
Address

QUANTITY	MATERIAL	PRICE	EXTENSION	
				Extensions
				Checked by
				Entered in
				L
				FORWARD
				THIS
				TO OFFICE
Foreman on job	Signed by	TOTAL		

Fig. 12 Credit form, when material is returned.

Handling of Scrap Materials

The handling of second-hand material and scrap is very important, and unless a proper record is taken of all second-hand and scrap material as soon as it begins to accumulate considerable loss will result. All scrap should be collected and stored promptly, and as soon as it accumulates it should

be sold, as it is very seldom that old material improves with age, and, while fluctuations in the price of metals may warrant the holding of some material for a short time, it is not desirable to keep it indefinitely in the hope that prices will go up.

General Observations

Some may think that an elaborate system of stock records require too much work and provide too many records, but shortages in material are just as expensive as shortages in cash, and there is no reason why one should not be safeguarded as much as the other. Managers of some factories jealously guard the cash collected daily, which amounts to a few thousand dollars, and it is placed in a bank promptly, even petty-cash accounts must balance to the cent. Let them exchange their cash for material and, beyond checking bills, interest often flags. The Storeroom of any well-organized plant are deserving of the attention and study of every live manager, since much money may be saved by the operating on an efficient basis of this branch of the plant. It is better to have a few extra records and protection than to omit these records and take chances of shortages. In a corporate business, it is the small items which must be closely watched to insure the accomplishment of the greater and bigger tasks which follow business development. Things that seem trivial to the average employee really mean a great deal in the long run if abuses occur, and the old adage, "A stitch in times saves nine," applies very appropriately to the safe-guarding of storeroom materials.

Opening of the "Rockland" Office of the Bell Telephone Company, Rockland Avenue, Outremont, Quebec

On February 28th the Bell Telephone Company of Canada opened its eighth branch office in the Montreal district. This office, known as "Rockland," is located on the east side of Rockland Avenue, just north of Van Horne Avenue, and serves a territory bounded on the east by Park Avenue and extending to Back River, on the line of C. P. R., on the south by Mount Royal Park, and the west on a line near Cote des Neiges Road. This area will take care of the subscribers' lines in the town of Outremont, Mount Royal Heights, Cote des Neiges Village, Model City and Park Avenue extension, the territory extending indefinitely to Back River. About 2,000 subscribers' lines were taken from the St. Louis office and transferred to Rockland at the time of the opening.

The building and equipment of the "Rockland" office corresponds very closely to that supplied for the "Victoria" office opened in July, 1913, and described in the "Electrical News." The building is 88 feet long by 40 feet wide, two storeys and with a high basement, designed to carry another storey in the future. The construction throughout is of the best fire resisting type. Special attention has been paid to fire protection, stand pipes with the standard two and one-half inch hose being placed at different points in the building. Sprinklers are placed on the outside of the building over all windows on the upper storey. The front of the building is finished with hard burnt Laprairie plastic brick, No. 1 quality, and limestone trimmings. The design is of a simple, dignified character with a large window area, giving the building a maximum of light and air.

The main entrance is on the front facing Rockland Avenue, the vestibule of which leads into a commodious entrance hall, from which the operators' quarters are entered, occupying the north half of the ground floor fronting on Rockland Avenue. The operator's quarters contain a lunch room, kitchen, rest and retiring rooms and sick room. In the basement beneath is the locker room, reached by a private staircase, as well as the operators' toilet and bath rooms.

The south half of the ground floor is entirely devoted to the housing of the power and terminal apparatus associated with common battery switchboards of the type installed. The entire top floor is used as an operating room and contains the subscribers' and incoming trunk switchboards. It is particularly well lighted and well ventilated. The whole of the central portion of the floor of the operating room, that is between the switchboards, is raised 13½ inches higher than that portion of the floor on which the switchboards stand. This construction permits of the operators sitting on chairs of normal height, and, at the same time, more readily permits of their making any connection to the most distant parts of the switchboard which they are obliged to reach. At the same time access to all parts of the back of the switchboard is exactly the same as in buildings of earlier construction where the entire floor of the operating room is on one level. A good fire escape is provided outside the building, reached by doors swinging outward from the operating room and from the operators quarters to the ground. In the basement are situated furnace and coal rooms, men's lavatories, battery room and cable terminal entrance.

The switchboard equipment is of the latest standard common battery relay type, and was supplied by the Northern Electric and Manufacturing Company, Montreal. The lines enter the building underground in lead covered, paper insulated cables and are connected to the main frame by silk and cotton covered insulated cables. The main, intermediate and relay frames, the coil racks for the lines and in-trunk switchboards with their fuse panels, the power plant and two-position inspector's desk are located in the terminal room at the east end of the ground floor.

The power plant consists of the main battery of 11-G chloride cells and a smaller set of 11-E-11 cells, the latter battery being used to reinforce the main battery for long distance work. Two Western Electric Company's motor-generator sets are provided for charging the larger battery, one being held in reserve in case of a breakdown. Each consists of a Western Electric Company's generator of 18,000 watts capacity at 30 volts, directly connected to a 30 h.p., 550 volt, 3-phase, 25-cycle motor. The generators are of a standard telephone design specially built for charging telephone batteries, having a large number of segments in their commutators and with peculiarly shaped pole pieces, the idea being to eliminate noise from the associated telephone service when the battery is being charged. The smaller battery is charged by a smaller generator which has an output of 600 watts.

Two machines are provided for furnishing alternating current for ringing subscribers' bells and with special interrupters arranged to give automatic intermittent ringing of subscribers' bells on calls originating from the other offices. These interrupters give an interrupted direct current to work the many signalling circuits required for an equipment of this type. The necessary switches, circuit breakers, measuring instruments, etc., are mounted on a black slate switchboard. From this terminal room the lines are run to the switchboards on the floor above in switchboard cables supported on structural steel runways.

Two separate switchboards are provided, one to care for the subscribers' lines directly connected to this office and the other one, the in-trunk switchboard, to complete connections that originate from the other offices. Both switchboards have a capacity of 10,400 lines and are equipped for 4,000 lines. They are equipped with the latest types of circuits; those of the in-trunk switchboard include the keyless incoming trunk circuits.

All the structural steel telephone apparatus in the terminal room is painted with aluminium paint (not the usual grey iron filler paint) and gives the room a bright and cheerful appearance. The new scheme of cutting over by operating the cut off relays electrically was used and proved very successful.

Electric Railways

Track Construction and Maintenance

By Mr. L. A. Mitchell*

The location of a line of railroad is generally governed by the topography of the country between the points it is intended to connect, but the topography too often receives too much consideration, or, rather, an alignment is established with the idea of evading heavy grading work and with too little consideration of the grades and curves that will exist and will have to be operated over after the line is completed. After the preliminary survey has been made and the topography of the country is thoroughly known to the engineer, he instructs his locating party to locate a line with a certain limiting degree of curvature and limiting gradient. These two are inseparable, as a curve of any given degree will offer to the operation of a train a resistance which is equivalent to a certain grade.

Train Resistance Due to Curves, Grades and Sliding Wheels

It is unfortunate that the experiments for determining the amount of curve resistance to the operation of a train have not been more numerous or more satisfactory. The results which have been obtained, however, show that in all probability the resistance of a curve is about ½ lb. per ton per degree of curvature. The resistance offered to train operation due to grade is 22.4 times the rate of grade per 100 ft. per ton or 14/33 times the rate of grade per mile. This equation and the first on curve resistance may be combined, and it will be found that a 1-deg. curve will offer resistance equal to a grade of 0.025 ft. per 100 ft.

It can readily be seen that for flatter curves the resistance to train operation due to curvature for single-car trains will not be great, but in the operation of 100,000 car miles this resistance will be considerable. Nearly all electric railways are compelled to have curves of 100 deg. or greater, on account of passing through towns and cities, and, according to the preceding assumption, a 100-deg. curve would be equivalent to a 2½ per cent. grade on tangent track. However, I do not believe any of the experiments noted were made on curves of such high degree, and no doubt other forces enter into the operation of the car around a curve of such high degree. On these sharp curves it is necessary to have guard rails, at least a single guard rail, and many engineers think a double guard rail is necessary. The wheels which come in contact with these guard rails necessarily offer greater resistance to the movement of the car than if no guard rails were present.

Another resistance is the sliding of wheels, both lateral and longitudinal. This resistance enters into train operation no matter what the curvature, but it is much greater on sharp curves. From the standpoint of maintenance, curves increase the cost of wheel maintenance as well as the cost of renewing rails. In addition, we have the increased amount of power necessary to carry a train over a given piece of track. Probably the most noticeable example of the resistance of curves is when we stop one of our heavy interurban cars with one or both trucks in a sharp curve, particularly when the line voltage is weak. With practically all wheels in contact with guard rails—and with the trucks at an angle, the resistance is maximum just before the car commences to move.

Drainage

Drainage conditions can very often be materially improved from a maintenance standpoint if proper consideration is given to this matter at the time the road is located and constructed. This has been especially neglected in the construction of city tracks. We can find many examples where it is almost impossible to keep the track in any kind of surface, owing to the fact that the water which has followed down along the rail or seeped through the street covering has found its way to the foundation of the track, where no way has been provided for it to get away. Such track will have to be rebuilt very much sooner than if a tile drain had been placed under the foundation and connected with sewer inlets at street intersections. If the track foundation is concrete, the tile drain should be laid under the concrete and surrounded by cinders, crushed stone or some other loose material so as to afford opportunity for any water that might get under this foundation to drain into the sewers. It is also advisable to place surface drains to take off any water that may run along the flangeways, at least at street intersections, and connect these to sewer inlets.

Foundations

Many of us in Ohio and Indiana found out several things about the foundations of our bridges after the flood of 1913. From what information I can obtain, I believe that not less than 95 per cent. of the bridge failures on both steam and electric lines were due to poor foundations. Almost invariably these foundations had not been carried deep enough or they had been placed on a material which is not considered reliable when subjected to excessive erosion.

Many foundations were found to have been placed on gravel varying from 1 ft. to 4 ft. or 5 ft. below the stream bed, and during the excessive high velocity of the water in the streams they were undermined and the superstructure damaged. It was found that other foundations were placed on a thin layer of hard pan which varied from 1 ft. to 3 ft. in thickness and was partly soluble in water. As this material was washed out the foundation failed. In one case the bridge abutment was placed on gravel, although solid rock existed about 4 feet below the base of the foundation.

If it was not known before, it was certainly proved during last year's flood that a gravel foundation for piers or abutments carried to any reasonable depth is not safe without driving piles. It has also been clearly determined that a stratum of hard pan should be of greater thickness than 1 ft. or 2 ft. before it is used as a foundation. In all probability, a stratum of hard pan should have a thickness of not less than 8 ft., and the foundation should be carried at least one-half of this distance into the foundation material. Fur-

* Superintendent Track and Roadway Union Traction Company of India; presented before the C. E. R. Ass'n., Cleveland.

ther, this hard pan should not disintegrate when allowed to stand in water.

Investigation as to the quality of material can easily be made by using a 2-in. or 2½-in. auger inside of a 3½-in. pipe. A sample of the material can be obtained as frequently as desired and to a considerable depth. This method, of course, will not be very satisfactory in a gravel-like material when any boulders are present.

Ballast

Ballast is a material that is just as essential to the riding qualities of good track as good rails and ties. Poor riding track which is so on account of poor ballast conditions introduces stresses into a car body which will eventually loosen nearly every joint of the whole structure. If the car is allowed to run until this condition is pronounced, it means ultimately that the extra car shop labor and material will cost more than proper track ballasting and surfacing.

The Pennsylvania Railroad, in 1911, made some rather extensive tests to determine the best kind of a cushion for broken stone ballast to be placed between the sub-grade and the ballast proper. Its experiments were made with the idea of using broken stone ballast entirely, but the object was to find out how much and what kind of material was the best to take care of the drainage of the ballast proper and also to distribute the load transmitted through the ballast over the sub-grade. These experiments showed that cinders and good clean gravel were probably the two best materials that could be used as a ballast cushion; also that about 2 ft. of either of these materials under the ballast proper gave the most uniform distribution of load over the sub grade. For the loads electric railways ordinarily carry, 1 ft. of this material would be ample thoroughly to distribute the load over the sub grade, and this with an additional 1 ft. of regular ballast, either stone or gravel, would give very excellent track. Inasmuch as cinders are a continuous by-product of most electric railways, it would seem that very excellent track could ultimately be obtained by using this material as ballast and then putting in gravel or broken stone on top of the cinders for the regular ballast course.

Cinders have a peculiar quality of absorbing water, nor do they wash away so fast as gravel when water flows over the track. On the other hand, cinders will compress and after use for a considerable time will have a more uneven surface than gravel.

Standard Construction Proposed for Sidings

For many years it was possible for electric roads to adopt standards for construction because their method of transportation was new and subject to rapid developments. I am submitting drawings as possible standards for side-track construction.

Fig. 1 shows the construction of the No. 9 frog used in the foregoing siding, with 70 lb. A. S. C. E. rail. This frog has been found to be very satisfactory. All of the plates under this frog are ½-in. thick, and all fillers are rolled steel. This frog has but one spring and one holding-down bar. It is fully equipped with foot guards and an anti-creeper. All bolts in this frog are of special heat-treated steel, whose elastic limit is not less than 75,000 lb. per sq. in. and whose ultimate strength is 100,000 lb.

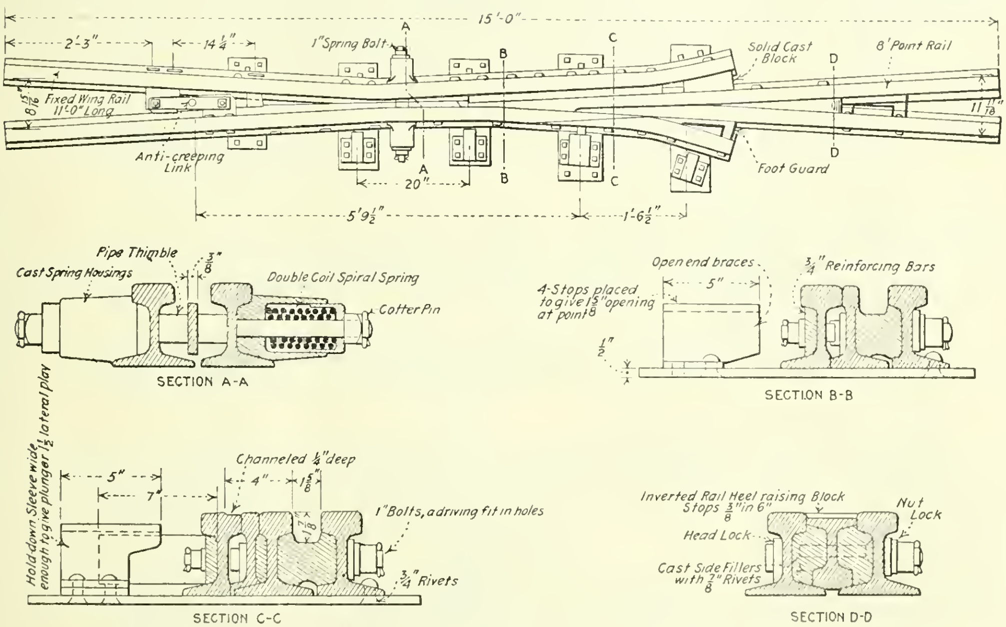


Fig. 1—Track Construction and Maintenance—Construction of No 9 Frog for through-type electric siding.

Fig. 2 is a detail of the switch points for this standard siding, showing dimensions of plates and rail braces; also the extent of the side and base planing. These points are 15 ft. long and are equipped with foot guards. One head rod is adjustable and the other two rods are rigid.

Street Construction, Including Joints

The foundation material, weight and section of rail and the design of switches and frogs are features of street construction which are very important, but I do not believe that there is any one thing that is of as much importance as the construction of the joint. It has been the experience of practically every electric railway that the joint has failed first and that reconstruction was made necessary on account

of the failure of the joints, whereas the rail in between the joints had many years of life.

In modern street construction four types of joints are used. All of these are tight, with the ends of the rails milled so that they will fit tight together with no allowance for expansion and contraction. These types are the driven-bolt joint, riveted joint, welded joint and the combination of bolted and welded or riveted and welded. As far as I can ascertain, the purely welded joint has given trouble. The only explanation I can see for this is that in applying the weld the ends of the rail are heated to a temperature high enough to change the molecular construction of the steel in such a way as to cause fractures of the rail just back of the weld. I have not heard of any failures of the combination joint where bolts or rivets and a small weld were used. I believe that

Where street track is constructed with tight joints and steel ties are used at the joints or throughout the total length of the track, joint bonds and cross bonds can be eliminated by welding the joint bars to the rail and the rail to the steel tie. All rail joints in street track should be ground to an even surface, as the specifications under which we buy rail allow for a possible maximum difference in height of the rails of 3/64-in., and this is sufficient to start a hammer which will very quickly cup the rails.

The foundation of street track is a question upon which engineers differ very widely. Some say that street track foundation should be absolutely rigid, others say that it should be elastic like open track construction, and still others say that it should be a combination of the two. Some engineers assert that they have obtained good results by placing

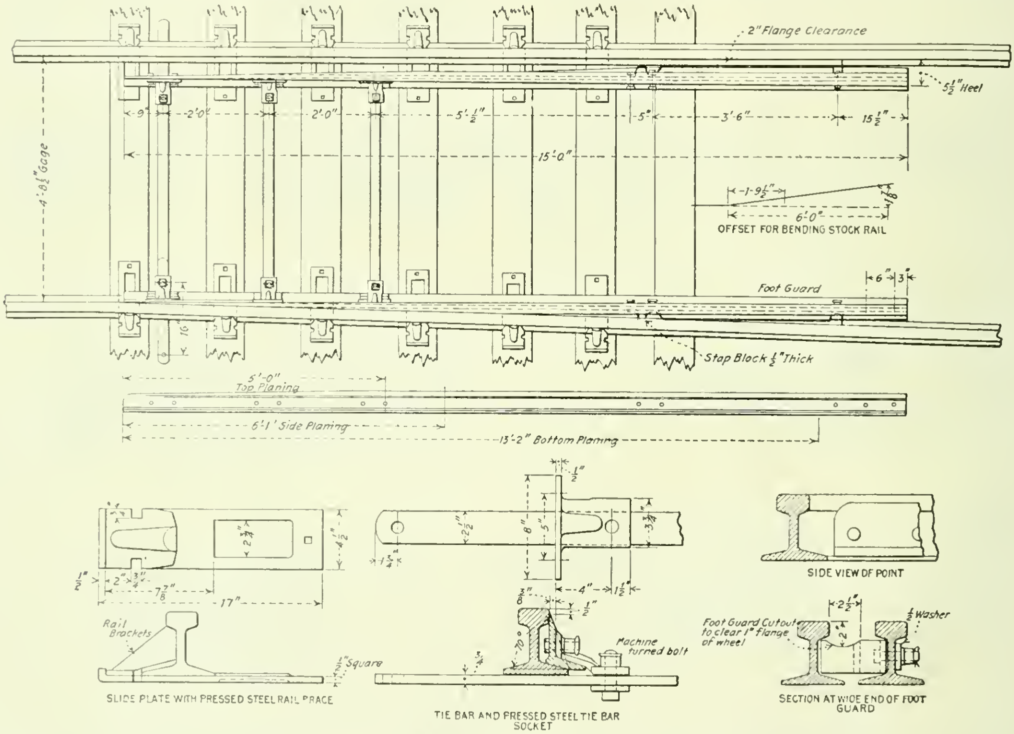


Fig. 2—Track Construction and Maintenance—Detail of switch points for standard siding.

practically as satisfactory a joint can be obtained as any now in use by using driving fit bolts or rivets and supporting the whole joint by means of a broad steel tie. This gives a supported joint, and if the rails are properly ground at the joint so that no hammer is allowed to start, this type promises as long a life as any now in use.

Some companies are buying their rails with the holes drilled or punched a fraction of an inch smaller than the size of the bolt that they intend to use. Then, by means of reaming machines, they ream these apertures out to a true round hole of the exact size that they wish to obtain. Very satisfactory results have been obtained, however, by having these holes drilled to the proper size at the rail mill and then using machine bolts of the same size as the hole. I do not believe that a joint bolt for street track of the heaviest type of construction should be less than 1⅛ in. in diameter. Fig. 3 shows the supported bolted joint described.

track on ordinary stone or gravel ballast, tamping it well and then concreting on top of the ballast as a foundation for the pavement only. Another type of foundation is to lay from 6 in. to 12 in. of concrete in the bottom of the trench, place in about 1 inch of sand, surface the track on this sand and then fill in to the proper elevation with concrete. The remaining method is to have concrete from the bottom of the trench up to the cushion for the pavement. It is impossible with any kind of ballast to tamp up track so that there will be no settlement, and consequently the pavement will finally work loose about the rails. It would seem, therefore, that a rigid foundation will give a construction which will require the least maintenance of track and pavement.

The proper type of rail for street construction has also been the subject of a great deal of thought. I believe that we will eventually come to the use of T-rails entirely, with a section of sufficient height to allow for paving. This

height should not be less than 7 in. A chamfered granite block has been found to give excellent service as a flangeway. Higher carbon steel rails have probably not been used sufficiently to determine the extent of their advantages and whether or not they are worth the increased expense. It is undoubtedly true, however, that for bolts a special steel is advisable. Special steel bolts with an elastic limit of not less than 75,000 lb. per square inch and an ultimate strength of 100,000 lb. are giving a very much stronger joint construction and are also rendering excellent service in built-up railroad crossings.

Guard Rails, Special Work and Crossings

In constructing short radius curves at street intersections it is a general practice to have the guard rail higher than the running rail. This is so whether the guard is rolled as part of the running rail or a rail is used as a guard. I have found it very satisfactory, however, to use a guard rail of the same height as the running rail, and to bolt this to the running rail every 2 ft. by 1-in. machine bolts with steel lugs holding the guard rail at the proper distance from the running rail to secure the proper flangeway. In case a rail is used as a guard rail, the method described gives a much more substantial form of construction than using a rail of less height than the running rail and supporting it on steel plates to give it the proper elevation because the equal height guard rail has, as a firmer foundation, the same ties that support the running rail. This equal-height construction also makes an easier riding street intersection for vehicles.

The raising of flangeways in frogs and mates so that the flange of the car wheels will ride while the tread of the wheel is passing over the opening in the ball of the rail has been widely discussed, and it has been stated that chipped flanges will occur where this type of special work is used. But if a car is operated at the proper speed over a piece of special work with raised flangeways, chipped flange trouble is not probable. A common mistake in the raising of flangeways is that the approach is made too steep so that the flange of a wheel will receive a strong blow when it comes in contact with the raised portion of the flangeway. We want to avoid pounding in the special work as well as at joints, and the raised flangeway with a long flat approach is the way to eliminate this hammer.

Railroad crossings and the expense of maintaining them have always been a source of much concern to both steam and electric engineers. Out of 152 railroad crossings during the year 1913, I had eighteen new installations, at an average cost of $260 per crossing. If I include these new crossings, my average maintenance cost per crossing was $68 for the year. An average maintenance cost excluding the cost of the new work but including the cost of installing it was $37.50. It is impossible to arrive at any average cost of maintenance for a railroad crossing, because it depends entirely upon the amount of traffic, but this cost can be decreased and the life of the crossing increased by having a construction which allows as little movement as possible between the various pieces. All of the frog bolts should be driving fit and of special steel, the filler should fit the rail sections under the ball and at the base, and machine knee braces should be used. A rigid inspection of crossings by taking them apart will often reveal a very poor fit between the fillers and the rails and also between the knee braces and the rails. To obtain rigidity in a crossing and reduce the possibility of movement between various parts, solid cast manganese crossings are used to a large extent.

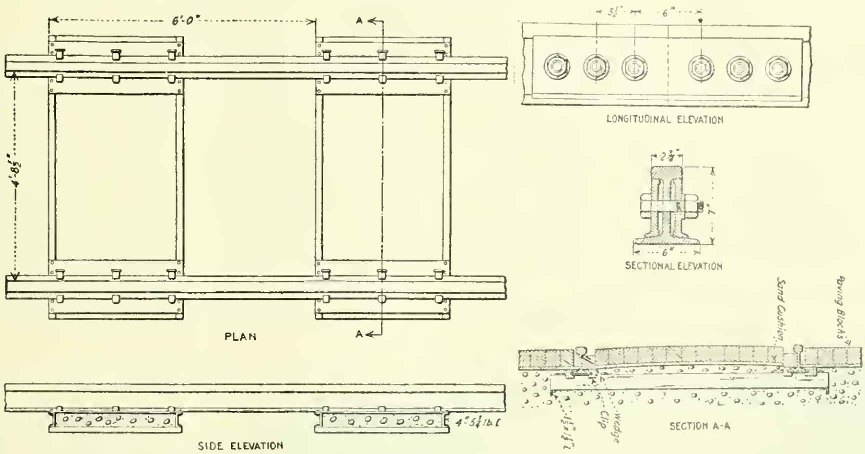


Fig. 3—Track Construction and Maintenance—Sections and plan of city T-rail construction; also details of joint.

Manganese steel, however, will break easily, and I am inclined to believe that the better type of crossing is the built up type with manganese steel running and easer rails.

The foundation of a crossing should be continuous throughout its whole length and should extend beyond the joints of the wing rails. In many cases timbers are used and placed under the steam railroad rails throughout the entire length of the crossing to give them a continuous support. I have found, however, that a steel structure consisting of channels and plates riveted together, filled with concrete and placed in its entirety on broken stone ballast gives very satisfactory results. A crossing with this type of foundation as installed under the two main line tracks of the Big Four Railroad did not require any attention for a whole year, whereas in the same length of time an ordinary built-up crossing installed at practically the same time, but without this type of foundation, showed considerable wear and was working to quite an extent, even though the traffic over it was probably less than one-half that of the crossings with the steel foundation. The latter showed very slight wear for the period mentioned. From my experience it looks as though this type of crossing foundation is a decided improvement over other methods, but it may be that longer ex-

perience will show that even this foundation can be improved.

Records

The cost of construction and maintenance work must be known to the engineer in order that he may determine, while the work is going on, that it is not more expensive than it should be. Materials purchased for renewals must be kept track of to ascertain if they are rendering proper and efficient service. To obtain this information the records must be such that the desired information will be at hand at the proper time and in the proper form.

B. C. Alterations

The B. C. Electric Railway Company have recently made alterations in the equipment which carries the company's transmission lines over the Second Narrows of Burrard Inlet, these furnishing light and power for North Vancouver and adjacent districts. The main transmission line from the generating plant on the North Arm is tapped in Burnaby at a point near the Second Narrows of the Inlet where the Inlet is so narrow as to afford a desirable point for such a crossing. The lines were originally carried on a pair of high wooden masts, these being erected about ten years ago. About two years later, during the high wind prevailing on Christmas Day, these original masts were broken down. A new pair of masts was then erected and have been in service since that time. With the development of industrial points at the head of the Inlet large vessels now pass through the Second Narrows from time to time and it became necessary, in order to accommodate the high masts of these vessels to raise the wires.

The old masts were two in number and of the single pole type, each composed of two poles properly fastened together and guyed. The north mast was 158 feet in height and the south mast 174 feet. The span between the two masts was 957 feet and the clearance above high water at the sag point of the wire was 123 feet. The new masts on the north side are 210 feet in height and on the south side 215 feet. The span between the masts is 951 feet and a clearance of 160 feet above high water mark is given at the sag point. The locations of the new masts are 50 and 25 feet respectively from the old masts, the plans providing for an entirely new construction and the demolishing of the old masts.

The new masts are of the double pole or "H" construction, each being composed of two-mast poles, placed 18 feet apart. On the north side the masts are guyed to a two-pole anchor tower, 130 feet in height. On the south side the mast is guyed to a four-pole anchor tower 95 feet in height.

The masts carry eight wires, these consisting of two 3-phase circuits, 34,600 volts and two telephone wires. The three-phase circuit wires are of galvanized plowed steel wire consisting of six strands of seven wires each. Each wire is of 2,500 circ. mill. area. The core is of hemp, this cable being one-half inch in diameter.

The two circuits are placed side by side at six-foot centres, the arrangement being vertical. The centre wire is offset two feet to increase the clearance when snow or sleet may prevail. The telephone wires are placed at the ends of the cross arms.

The complete transfer of the transmission lines from the old masts to the new construction was completed on February 21st. This being the only connection with the company's North Vancouver sub-station, which supplies current for a tram system and public and private lighting and power business, it was necessary that the interruption in connection with the transfer of the wires should be as brief as possible and at such times as would inconvenience the company's patrons but little.

Peterborough Radial Extensions

The Peterborough Radial Railway Company will carry on considerable extension work during the present summer. The city is laying one mile of pavement along the business street and the company are entirely removing their old tracks from this portion of their system and replacing them with 80A and Loraine 80-335 rail sections. In addition the company will install two maganese-steel railroad crossings and two crossings of built-up construction. The company are also running a siding to the C. P. R. depot and will operate a separate depot car in future, meeting all passenger trains day and night. At the present time the Peterborough Radial System is running on a 15-minute schedule, but additions to rolling stock and alterations at certain parts of the system will enable them in the early future to operate a 12-minute service and within a few months thereafter a 10-minute service.

The following judgment of Judge Winchester regarding the cleaning of snow from the streets by the local street railway company is of interest:—"I find that it is the duty of the Toronto Railway Company to keep their track allowances, whether for a single or double line, free from snow and ice at their own expense, so that the cars may be used continuously, and that if the fall of snow is less than six inches at any time the company must remove the same from the tracks and spaces if the City Engineer so directs, evenly spread the snow on the adjoining portions of the roadway, but should the quantity of snow exceed six inches in depth, the whole space occupied as track allowances (for double tracks 16 feet six inches and for single tracks eight feet three inches) shall, if the City Engineer so directs, be at once cleared of snow and ice and the said material removed and deposited at such point on or off the street as may be ordered by the City Engineer. And I find by Section 25 of the said Act that the Railway Company shall not deposit snow, ice, or other material upon any street or public place in the city without having first obtained the permission of the City Engineer."

New Books

Elementary Principles of Illumination and Artificial Lighting, by Arthur Blok, B.Sc., A.M.I.E.E.; Scott, Greenwood & Son, London, Eng., publishers, price 3s. 6d. This book outlines the principles underlying artificial illumination and its measurement as a subject in itself, quite apart from any consideration of the commercially competitive merits of particular illuminants. The book is addressed to students, engineers and such others as may be concerned with the distribution and installation of lighting equipment. A very practical treatise: well illustrated, by line sketches for the most part.

Wireless Telegraphy—By W. H. Marchant, Whittaker & Company, London and New York, publishers; price 5s. This is a handbook for operators and students who already possess some knowledge of electrical science. The book deals, in sections, with the production and retention of electric oscillation and waves, description and process of construction of the apparatus required for a radial telegraph installation, followed by a description of a number of systems—Marconi, Poulsen, etc. The final chapters deal with the apparatus necessary and the methods of carrying out all the more important measurements under special conditions. One chapter deals with the interpretation of diagrams; two chapters are given over to the regulation of instruments for licensed radial telegraph stations. The book is illustrated and written throughout in a very practical manner and is well printed.

Illumination

Indirect Residence Lighting

By Mr. A. D. Curtis

The illustrations herewith represent the scheme of illumination by indirect fixtures, in a private residence. Fig. 1 represents the reception room; Fig. 2 a general living room. Fig. 3 represents, as the diagram on the bowl will indicate, a dining room fixture. Fig. 4 is a general plan of the ground floor.

In the use of indirect units as shown in these reproductions, the excellence of illumination results depends very largely on the scheme of decoration of the rooms. It may be said in a general way that the nearer approach the decorations are to pure white, the more efficient the illumination will be, but it does not follow that all the rooms must be finished in this color. The walls of the reception room shown in Fig. 1 are decorated in green, which gradually merges into the cream color of the ceiling. The furnishings in general are green and mahogany. This room is 16 ft. x 15 ft. and is illuminated by four 60-watt tungsten lamps equipped with individual, one-piece, silvered, glass reflectors of the horizontal type, housed in an opaque bowl made of composition and finished to harmonize with the green decorations of the room. The length of suspension is 27 inches from the ceiling to the top of the reflectors.

The gross wattage is thus seen to be one watt per square foot. As shown in Fig. 4, which represents a plan of the ground floor of the residence under discussion, the horizontal lamp values are indicated at a number of points. In the reception room the illumination would appear to be ample if somewhat variable. In the extreme corner the intensity is .9. Indeed, the owner of this house finds the illumination values unnecessarily high and the lamps are controlled by a four-way switch which makes it possible to light either one lamp, two lamps or four lamps. This room is also equipped, as shown in the plan, with a portable indirect floor lamp which has replaced an art glass table lamp shown in Fig. 1. This lamp is equipped with one 150 watt tungsten lamp and a large vertical, one-piece, silvered glass reflector. The silk shade is illuminated by three 10 watt frosted tungstens. This art lamp was not in use when the tests shown were made.

The walls of the living room, Fig. 2, are finished in a light green with white ceiling, white woodwork and light furnishings. This room is illuminated with four 40 watt tungsten lamps equipped with individual silvered glass reflectors. The fixture is of composition equipped with a pull chain and suspended 27 inches from the ceiling. The illumination reading at the centre of this room gave 2.8 horizontal foot candles.

The decoration of the walls of the library is gold up to the moulding with a dark cream above the moulding extending to the ceiling and becoming a light cream as the ceiling is approached. The furnishings are brown and mahogany. This room is illuminated only by a portable indirect table lamp equipped with one 150 watt tungsten with vertical type one-piece silvered glass reflector and three 10-watt lamps for illuminating the shade. The gross wattage is approximately .75 watts per square foot. It will be seen from the plan that there is ample intensity for reading purposes anywhere in the neighborhood of the lamp. Furthermore, the lamp can be moved so as to get the best results in any desired location.

The decoration of the dining room is a blue above dado. The ceiling is white mottled with pale blue to give a sky effect and is heavily beamed. The furnishings are dark. The illumination is by means of five 60-watt lamps equipped with reflectors as before, the units being suspended 27 inches from the ceiling. The design of the unit is shown in Fig. 3. The gross wattage of this room is approximately .96 watts per square foot and illuminations are shown for nine different test positions.

The bedrooms are for the most part finished in light

Fig. 1—Indirect lighting of reception room.

Fig. 2—Indirect illumination in general living room.

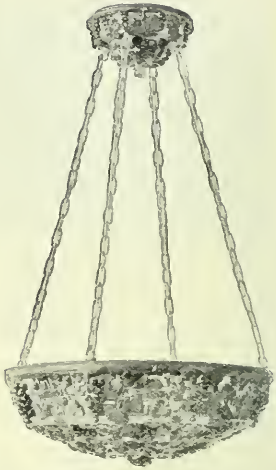


Fig. 3—An ornate fixture.

colors and indirect units are used throughout with wattages varying but below unity in each case. The same is true of the bathrooms, halls, kitchen, the den and porch. In this particular house a feature is made of the porch unit in that

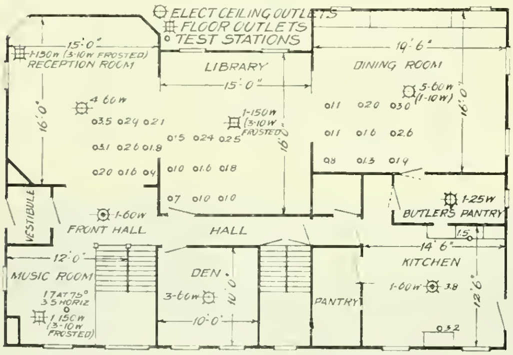


Fig. 4—Plan of ground floor of dwelling.

it is housed in wicker-work which gives to the room a summer-like atmosphere. The reflectors and fixtures in this installation were manufactured by the National X-Ray Reflector Company.

The Immediate Future of the Half-watt Mazda Lamp

By Mr. L. A. Hawkins*

The announcement last summer by the General Electric Company that an incandescent lamp had been produced with a specific consumption of one-half watt per candle naturally gave rise to much speculation upon the effect this new lamp would have on electric lighting. Since then, the characteristics of the new lamp have been fully described, but speculation continues and some misapprehensions are manifest. Therefore it may be worth while to devote a few minutes to a consideration of the probable immediate future of the new gas-filled mazda lamp.

It would be equally presumptuous and futile to attempt to anticipate developments by mapping out the metes and bounds of that portion of the field of electric lighting which the gas-filled mazda lamp will eventually occupy. It is not the purpose of this paper to make any such attempt, but rather, by considering some of the well established characteristics and peculiarities of the lamp, to try to determine the general direction of probable development which may effect that development.

When a gas-filled lamp is compared with a vacuum lamp, its most striking characteristic, aside from its higher efficiency and higher intrinsic brilliancy, is that its efficiency varies with the size of the filament. In vacuum lamps the efficiency at a given filament temperature is independent of the diameter of the filament, except for the relatively slight effect on loss through leads. In gas-filled lamps the diameter of the filament is an important factor in determining the efficiency. The reason for this is that at a given temperature the wasted energy, i.e., the heat lost by conduction in the gas, is practically independent of the filament diameter, while the useful or radiant energy is proportional to the surface, and therefore to the diameter of the filament. Langmuir gives the specific consumption of a tungsten filament at 2800° Abs. (2527°C.) in nitrogen at atmospheric pressure as 1.54, 0.74 and 0.50 watt per candle for filaments of 1, 5, and 50 mils dia. respectively. It is clear from these figures that the large filament has, in nitrogen, an advantage over the small filament which it does not have in vacuum. Nor do these figures tell the whole story. A 5 mil filament at 0.74 watt per candle, and a 50 mil filament at 0.50 watt per candle, though running at the same temperature, will not have equal lives. The large filament should outlast the smaller several times. In order to get a comparison based on equal lives the specific consumption of the smaller filament must be raised or that of the larger lowered. The difference in efficiency will then be more marked.

At best in large sizes

The gas filled lamp is thus at its best in large sizes, and it is therefore in large sizes that the first commercial development should be looked for. Large size means large

* Engineer, Research Laboratory, General Electric Co.

filament diameter and that means large current. The filament can and should be coiled in a close helix, so as to give the effect of a larger diameter, but the permissible diameter of the helix is limited, because, if it is made too great in proportion to the diameter of the filament, the filament will sag rapidly early in the life of the lamp and the efficiency will fall correspondingly. Therefore, even though the filament is wound in a helix, the specific consumption is relatively so much greater in low current lamps that the first commercial lamps, except for special purposes, will naturally be designed for currents above, rather than below, 5 amperes. For multiple circuits of 110 to 125 volts, this means lamps of over 600 watts, in which specific consumptions of 0.75 down to 0.6 w.p.c. in the larger sizes can be looked for.

Lamps of such wattage and candle-power are so far removed from the sizes of lamps adapted for house-lighting that it is not to be expected that the gas-filled lamp will be scaled down in the near future to house-size.

But there are other circuits on which the high efficiency mazda of more than 5 amperes is immediately applicable. Most street series incandescent circuits now carry 6.6 or 7.5 amperes, and on such circuits the new lamp can be substituted directly for the old and reduce the specific consumption to about 0.7 w.p.c.

A better efficiency is obtainable on alternating current circuits by using a lamp of 20 amperes or more, with a compensator to transform the current to the proper amount. With such a lamp a life of well over 1,000 hours can be obtained at a specific consumption measured on the primary side of the compensator of not more than 0.5 watt per candle.

The Effect on arc lamps

This combination of a high current lamp and compensator has several advantages over a lower current lamp designed for direct connection in the circuit, other than its higher efficiency, amounting to at least 30 per cent. more light for the same wattage. In the first place, on a series circuit, some kind of shunt protection is necessary to take care of burnt out lamps, and a shunt reactance is one of the simplest forms of such protection. This, in effect, is what the compensator is. Secondly, since these new lamps run much nearer the melting point of the filament than do the vacuum lamps they are more sensitive to excess current. The compensator can be designed to reduce the current rise in the lamp for a given rise in the series circuit. Even if the compensator is not designed to give this effect, the greater mass of the large filament, with its time lag in temperature, makes it less sensitive to sudden rises of current than is the lamp with the smaller filament. This time lag is very noticeable when current is thrown on or off a 20 ampere lamp. There is a very appreciable interval before the lamp reaches full luminosity or falls below incandescence.

On the basis of equal life, the large filament runs at a somewhat higher temperature than the smaller filament and therefore gives a somewhat whiter light, but this difference would not ordinarily be noticeable except where direct comparison is possible.

The 20 ampere lamp, with its high efficiency, high intrinsic brilliancy, and relatively white light, enters directly into the arc lamp field. Its efficiency is about three times that of the enclosed a.c. arc of 6.6 amperes, which still lights more miles of street than any other lamp, and is on the same order as that of the luminous arc. In connection with relative efficiencies, it should be remembered that it has been the practice to rate incandescent lamps in watts per mean horizontal candle-power, the measurements being taken on the bare lamp, while arc lamps are usually measured complete with casing, reflector and outer globe and rated in watts per mean hemispherical candle-power. In making comparisons care should be taken to reduce efficicandle-power and wattage.

The 20 ampere half-watt mazda seems certain to find a field in street lighting. It can in the present state of its development be made efficiently in sizes as small as 300 watts, 600 candle-power, or even smaller by resorting to special expedients to prevent excessive heat loss through the leads when the filament length is reduced below that corresponding to 15 volts. There is no upper limit to the candle-power and wattage.

In connection with outdoor applications, one point is of interest and importance. The bulbs of nitrogen-filled lamps run much hotter than those of vacuum lamps. Temperatures approaching 200 deg. C. or even higher are to be expected. The reason is that, whereas in the vacuum lamp much the greater part of the energy in the filament is radiated directly through the bulb without heating it, in the nitrogen-filled lamp much the greater part of the energy is taken up by the gas as heat and so delivered to the bulb, with the result that the top of the lamp especially runs very hot. Now when cold water is suddenly thrown on an ordinary glass bulb at 200 degrees C. the bulb cracks. Therefore, for outdoor use it is necessary either to make the bulbs of special low-expansion glass than can, when hot, withstand a sudden cold shower, or so carefully to house the lamp as to prevent the access of water. Housing is not a disadvantage for the larger lamps, since the intrinsic brilliancy is so high that a diffusing outer globe is desirable to prevent glare, and for the 20 ampere lamps the compensator must be housed anyway. In the design of the housing, however, it is necessary to provide adequate ventilation. A lamp which will last 1500 hours if properly ventilated will not last 50 hours if the ventilation is insufficient. This is because over-heating of the glass sets free water vapor within the lamp which attacks the filament and rapidly spreads a dense black deposit over the bulb. Therefore if the lamps within it are to have a reasonably long life, the housing must be designed with a knowledge of the lamp requirements and its temperature limitations.

A street lighting proposition

It is often asked what effect the half-watt mazda will have on arc lamps. In all probability its effect will be to make better arc lamps. The high efficiency, brilliancy, steadiness, relatively white light, and low cost of maintenance, will make the new lamp a dangerous competitor of the arc lamps; but the case of the arc lamp is far from hopeless. Half a watt per candle is a higher specific consumption than that of the most efficient arc lamps to-day, and in the race for still better efficiencies the arc lamp has the great advantage that, whereas at about 0.2 watt per candle a tungsten filament reaches its melting point, there is no such fixed limitation on the efficiency of the arc. In brilliancy the arc has a slight, but very little advantage. The slight relative unsteadiness of the arc is not a disadvantage in the eyes of some, who see in it a snap and vivacity which is lacking in the steady though brilliant incandescent lamp. The half-watt mazda, while much more nearly white than the one-watt per candle mazda, is not so white as the luminous arc or the white flame carbon arc. Further increase in arc lamp efficiencies will lower the cost of maintenance per candle-power, and, especially where the cost of power is high, will give the arc lamp a decided advantage.

Thus it is altogether probable that the net result of the advent of the new lamp in the arc lamp field will be that better incandescents and better arcs will co-operate in furnishing better street lighting systems for all conditions. In some cases those conditions will best be met by the mazda, and in others by the arc.

The Dealer and Contractor

"Doing It Electrically"

The proven utility and convenience of the electric motor coupled with the reasonable rates charged for electric energy in Winnipeg are responsible for the fact that a great many of the general contractors have purchased electric motor-driven equipment for their building operations.

The National Construction Company, Limited, deserve special mention as one of the progressive contracting firms. Nearly all of their hoisting machinery, derricks, and concrete mixers are motor-driven. On the new Law Courts Building, now under construction for the Manitoba Government, seven motor installations have been made and not

All construction machinery is electrically operated.

one break-down from an electrical standpoint has occurred. At the present time the following motor load is connected up and in service:—

Motor No. 1—Derrick	22½	h.p.
Motor No. 2—Lift	7½	h.p.
Motor No. 3—Derrick	15	h.p.
Motor No. 4—Saw Rig	5	h.p.
Motor No. 5—Derrick	15	h.p.
Total	65	h.p.

All of the above motors are three-phase, 60-cycle, 550 volts, except No. 2, which is a 500 volt d.c. motor.

Graphic Meters

A complete line of continuous writing curve drawing instruments has recently been completed and placed on the market by the Esterline Company, Indianapolis, Ind. These instruments are now furnished for the measurement of all electrical quantities such as volts, amperes, watts, etc. Electric speed recorders, service recorders, pyrometers and graphic counters are included in this line. These meters are furnished in switchboard rear connected type, wall or front connected type, and portable type. The general construction of all these types is the same with the exception of the case and the method of making connections. The clocks, meter elements and recording mechanism are the same in all types.

The instruments are of the direct writing type. The pen, which is in contact with the paper at all times when writing, is placed in the end of a tubular pointer which is pivoted and provided with a counter-weight. The pressure of the pen on the paper is regulated by this counter-weight which is adjusted so that there is just sufficient pressure to hold the pen on the paper without creating heavy friction. The ink supply is retained in a stationary well provided with a cover to prevent spilling of the ink when instruments are moved about.

The clock is of the eight-day jewel balance wheel type. It is provided with two driving springs and a third spring which operates the rerolling device provided for winding up the finished chart. On some types, the reroll is omitted and the finished record allowed to feed through a slot in the bottom of the case. The clock is fitted with a driving

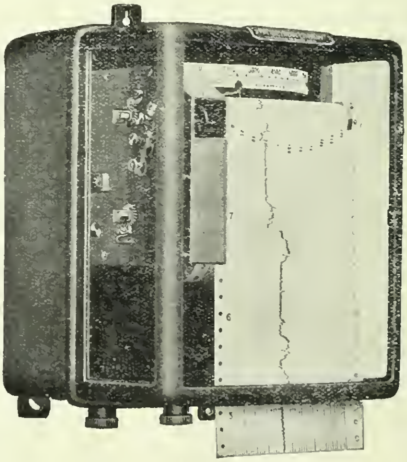


Fig. 1. Wall type meter.

roll equipped with pins at each end which engage perforations along the margins of the record chart. The driving roll is geared through the two idlers to the clock stud which furnishes the driving power. Different combinations of gears are supplied so that five chart feeds, ¾, 1½, 3, 6 and 12 inches per hour may be obtained on any clock by putting on the proper gears. For furnishing rapid chart feeds, a special attachment is provided on the clock, arranged so that shifting a small lever on the front of the clock case instantly changes the chart feed from a given number of inches per hour to the same number of inches per

minute. The clock is mounted in a dust-proof case and attached to the door, which in turn is held in the case by four screws.

Meter elements are assembled complete in one unit and may be removed from the instrument without dismantling. For direct current ammeters and voltmeters a powerful D'Arsonval permanent magnet type movement is used. For direct and alternating current wattmeters, alternating current voltmeters and ammeters a dynamometer type construction is employed. No iron is used in the magnetic fields of the dynamometer movements so that meters of this type are accurate on all frequencies and respond promptly to voltage or load variations. The armature shaft of the meter element is provided with a bracket which carries pivots in which rest the pointer carrying the pen.

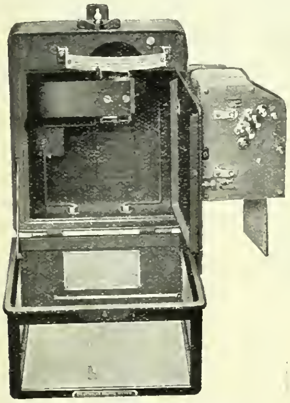


Fig. 2. Interior view wall type.

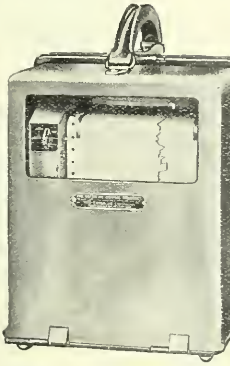


Fig. 3. Portable type.

Alternating current instruments are provided with adjustable damping devices consisting of a rotating vane immersed in a small cup containing oil or some other viscous liquid. The amount of damping is varied by adjusting the height of the cup, the quantity of oil or the quality of the liquid. Direct current meters do not require damping as the armature is wound on a metallic frame in which eddy currents are induced when the armature rotates in the magnetic field of the permanent magnet.

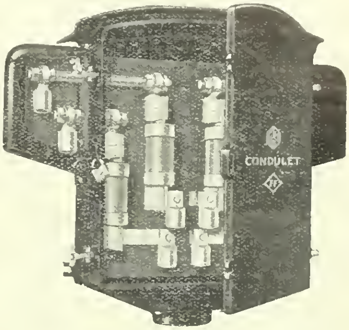
The power consumption on these instruments is so low that they may be operated from shunts or transformers already installed. Voltmeters and wattmeters require from 4 to 5 watts for each voltage element on 110 volts. Direct current ammeters consisting of millivoltmeters and shunts require only about one-third ampere for the instrument. Due to the direct writing construction, no extra control circuits of any sort whatever are made use of.

These instruments are used on switchboards for obtaining voltage and output curves. They are used for getting power consumption of motor driven tools and for general efficiency engineering. These instruments are especially valuable when it is desired to get an accurate record of power consumption in circuits where the load is fluctuating very rapidly.

The Allen-Bradley Company announce that their Chicago representative, Mr. Frank L. Gohl, has moved from his old quarters at 540 Commercial National Bank Building, to 307 Webster Building, 327 LaSalle Street, Chicago, Ill. This change was necessitated by the decided increase in business, the old offices proving too small

New Condulets

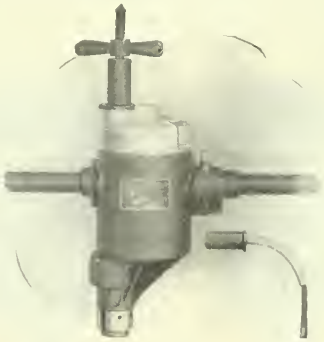
The accompanying cut represents a new type of condulet designed for use where conduit is used to protect, from mechanical injury, service wires from an overhead system. For this condulet three advantages are claimed. First, in case of short circuit in the conduit the fuses open the circuit. Second, a short circuit on any one of a number of individual services is localized by the intermediate fuse protection thus saving the transformer fuses and preventing interruption in the other services supplied from that transformer. Third, it is possible by removal of the fuse to completely disconnect the service outside the building. These condulets are made in two forms—a smaller form for use with 30, 60 and 100 ampere cut-outs and a larger form for use with 200, 400 and 600 ampere cut-outs. This material has been placed on the market by the Crouse-Hinds Company of Canada.



New type condulet.

A Universal Slow Speed Control

The illustration herewith represents a new type of Van Dorn electric drill fitted with a slow speed universal motor.



This drill is especially adapted for work in marble, tile, switchboards, billiard tables, etc. The Canadian agency is held by Messrs. R. E. T. Pringle.

The town of Outremont, Que., have just closed a contract with the Eugene F. Phillips Electrical Works, Limited, for the supply of over 20 miles of paper insulated, lead covered, steel taped, armoured cable for a working pressure of 6,600 volts. This cable will be installed under a five year guarantee.

Bottom Connection Meters

After discussing the subject for several months the B. C. Electric Railway Company have decided to alter their policy with reference to the type of meters used for their light and power connections. Heretofore the company have almost exclusively used "top connection" meters. The company's new policy demands the use of "bottom connection" meters. Among the reasons for the change brought forward at the departmental discussions on the subject were the following:

(1) Meters are very often installed in damp locations. In such cases the "top connection" does not afford proper protection for the equipment, whereas the "bottom connection" affords well nigh perfect protection.

(2) The requirements of the civic and municipal electrical bureaus demand that meters shall ordinarily be installed at a considerable height. Under these circumstances it is difficult to closely inspect the contact points with the "top connection." With the "bottom connection" the condition of the contacts can be seen from the floor at a glance.

(3) Should there be loose contacts and consequent overheating with the "top connection" the melting of the terminal would result in the flow of the metal into the meter.

(4) With the use of the "bottom connection" it is comparatively easy to notice any attempt to tamper with the meter owing to the connection several feet lower down, not concealed in any way and affording a chance to see the inspection seal without trouble. With the "top connection" the company has found that it is possible to tamper with the meter in such a manner as to escape the casual notice of the inspector.

(5) In the case of testing the meter the operation may be carried on with much less difficulty where the "bottom connection" is used.

The new policy of the company will go into force in the near future and their contracts for meters be based on specifications framed accordingly. All new meters placed will be of the new type and the "top connection" meters now installed will be replaced as soon as their life is ended.

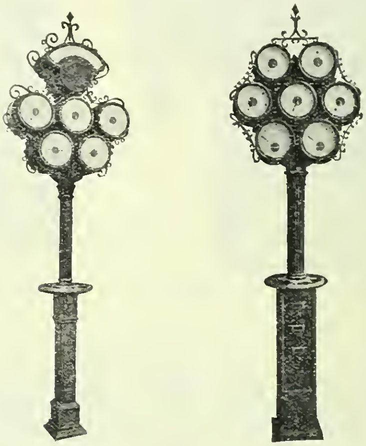
New Hubbell Plugs

The two cuts herewith represent the latest development in Hubbell attachment plugs. The reproductions are the exact size of the plug. This plug is for use in an ordinary lighting socket where contact is to be made and broken frequently, as in portable equipment such as table lamp, toaster, per-

colator, etc. The base of the plug screws into the receptacle in the ordinary way and the push-in cap fits snugly into the base. To break the current this cap requires only a slight pull which does not disturb the base or strain the socket. When inserted in the socket the cap projects only about half an inch so that the device is unusually neat.

Instrument Posts

Instrument posts, as shown herewith, are now used whenever a device is required upon which to mount meters in a power station in place of using an instrument switchboard. The wiring is concealed in the interior of the posts. The advantage of instrument posts over panel switchboards are that they permit a very convenient and ornamental mounting for meters, beside locating them in such a position that they can readily be observed without obstructing the general view of the operator. The usual arrangement is to place these posts so as to form a support for the railing of an operating gallery, each post being placed in front of its respective controlling apparatus which is usually located on a suitable controlling pedestal. The posts may be secured to the floor either by bolting the shank to the side of channel iron beams located under the floor, or by using a bolted flange collar, secured to the post and provided with holes for holding down



bolts. When a concrete floor is provided, a socket can be supplied which may be set into the floor, and which is arranged for bolting to the flange collar. The standard ornamental posts have plates provided at the places where hand railing is usually attached, but when required hand rail bosses may be substituted. These bosses are drilled to take a standard 2-inch pipe, 2⅜ inches outside diameter. Posts with panel bases cannot be arranged for hand railing. Two styles of pedestals are made, with ornamental bases and with panelled bases suitable for mounting control apparatus. Each of these styles is also made with stationary top and with swivel top which can be turned about by means of a handwheel just above the base. These instrument posts are manufactured by the Westinghouse Electric and Manufacturing Company.

The Ferranti Electrical Company of Canada, Limited, have just been appointed sole agents for Messrs. Bruce, Peebles & Company, Limited, Scoltand, for the province of Ontario and all Western Canada. As is generally known Messrs. Bruce, Peebles & Company build all classes of electric motors and generators, large alternators, motor generator sets, rotary converters and also the Peebles La Cour converter. It is interesting to note that the first La Cour converter to be installed in Canada has just been completed at Regina. In Great Britain and in South Africa where these machines have been on the market for some years, they are already securing a very large proportion of the business in converting machinery.

Universal Chemical and Electrical Laboratories

A company known as the Universal Chemical & Electrical Laboratories has recently been formed at Waterford, Ont., and has taken over the building formerly occupied by

Factory of new company.

the Dominion Telephone Manufacturing Company. The new Company propose manufacturing, on an extensive scale, telephone supplies, electrical fixtures, etc.

Electric Curling Iron

The electric curling iron supplies the long-felt demand for a simple, reliable, and economical self-heating curling iron. By its use the fire hazard of the flame iron is eliminated and a uniform and more easily controlled heat is obtained. A new electric curling iron is being manufactured and sold by the Westinghouse Electric and Manufacturing Company. This curling iron can be used with stored heat, as with the flame-heated curling iron. In addition, it can be used with continuous heat, a use which cannot be obtained with the flame-heated iron. For use with stored heat, the iron is first heated by connecting it to the electric circuit.

When it is hot, the swivel plug is pulled out, disconnecting the cord and electric circuit. It is then like the flame-heated curling iron and is used in the same manner. When it gets cold, the plug is pushed into place until it is hot again. When it is used with continuous heat, the swivel plug enables the user to grasp the iron in such a way that it can be freely rotated by the thumb and fingers without twisting the cord. It can be used with or without the hair clamp, which is easily removable. As the input is only 15 watts, it costs only about one-tenth of a cent an hour to use this curling iron with the average price of current.

Refillable Fuses

At a recent convention of the Western Association of Electrical Inspectors it was recommended unanimously that Rule 68 of the National Electric Code be so revised as to permit the use of refillable cartridge fuses. A report of the proceedings of this convention discussed the matter as follows; we are indebted for this report to the Economy Fuse & Mfg. Company, Chicago,—

"The subject of refillable fuses was again brought up from the preceding day's discussion, by Victor H. Tousley, Chicago, who moved that the Association recommend that Rule 68d be so revised as to permit the approval of refillable cartridge fuses. This motion was carried unanimously. Before this matter was dropped, however, H. E. Bloomer, Milwaukee, Wis., asked as to the experience with refillable fuses. A number of speakers said that one type of these had proven very satisfactory; that these fuses had stood up under severe tests and seemed to meet all requirements. B. H. Glover said the Underwriters' Laboratories have not recommended any refillable fuse because Code requirements do not permit such approval. A certain type of refillable fuse had met all the requirements of rating and performance but could not be given formal approval on account of the restriction just mentioned. F. A. Barron said he regretted to see the Association apparently take a stand which meant really a lowering of standards in fuse requirements. There is no doubt abuse of standard cartridge fuses on account of the fallibility of the human element, but he doubted the wisdom of the proposal to approve any type of refillable fuse.

A. L. Eustice, Chicago, replied to Mr. Barron by pointing out that the best opinion in the inspection field seems to welcome a reliable form of renewable cartridge fuse as a solution of the vexatious fuse problem. He felt that the opposition to the use of renewable fuses was based entirely upon theoretical grounds; experience in the field with various types of renewable fuses has shown that renewable fuses can be built that will meet the performance requirements and solve the old difficulties of improper fusing. It has been conclusively shown that a proper type of renewable fuse can be and is being properly renewed and is therefore suitable for certain cases where there is evident need for a fuse of this type. In industrial plants, where unavoidable conditions cause frequent blowing of fuses, it is necessary that renewals of the fuse be made at moderate cost. If this is not done an improper fuse element will be inserted. A fuse is used for the very purpose of safeguarding the circuit and apparatus to which it is connected and it should blow when an abnormal load or other condition exists. Records of jobbers show that repeat orders for standard non-renewable fuses are not received to any extent after the first order, showing that the fuses are not being replaced by new units but are refilled on the premises, evidently in an improper manner in altogether too many cases. A properly constructed renewable fuse permits easy inspection of the fuse element and this insures that it is being properly refused. The denial of renewal results only in the temptation to improperly defeat the object of a fuse."

Well Equipped Electrically

The new factory of the Canadian Connecticut Cotton Mills at Sherbrooke, Que., is practically completed and will be one of the best equipped factories, from an electrical view point, in Canada. The Canadian General Electric Company have the contract for the supply and installation of the electrical equipment including motors, transformers and other apparatus.

There will be 28 squirrel cage induction motors, 3-phase, 60 cycle, 550 volts, located as follows:—

Locality	Motors	H.P.	R.P.M.
Opening Room	1	10	1800
Weave Room	1	15	1800
Picker Room	2	10	1800
Picker Room	3	5	1800
Carding Room	1	50	900
Carding Room	1	20	1800
Carding Room	1	35	1200
Spinning Room	8	20	1800
Spinning Room	5	10	1800
Weave Room	2	35	1200
Twisters	2	25	1200
Cloth Room	1	20	1800

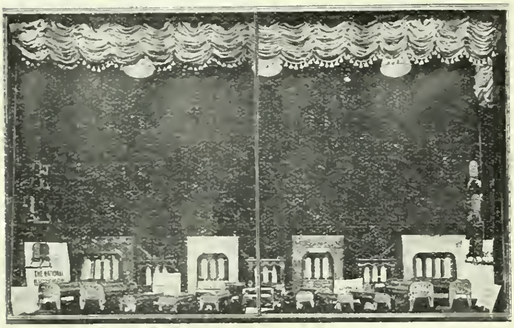
The switchboard consists of six natural black slate panels equipped with horizontal edgewise instruments and K-5 oil switches. One panel controls the 2200 volt incoming line and a three-phase transformer stepping down to 605 volts. Provision is made on this panel for reading the current and voltages in all three phases. The three main power feeder panels are all equipped with one ammeter arranged

to read the current in each phase, one indicating wattmeter and series trip oil switch. The fourth power feeder panel controlling two small capacity circuits is equipped with quick-break fused knife switches. The sixth panel controls single phase lighting circuits and is equipped with plain lever fused switches, one voltmeter and one ammeter.

The transformer equipment consists of three oil-cooled 300 kv.a. single-phase, 60-cycle, 2200/2145/2090/1980- 608-volt units.

Efficient Heaters

The Toronto Hydro-electric Department recently showed a very interesting window display of electric heating equipment manufactured by the National Electric Heating Company, Limited, Toronto. The exhibit consisted of portable units in sizes from 660 to 3,000 watts and wall type units in 1,500 to 10,000 watt sizes. It is claimed for these heaters that an installation of $1\frac{1}{2}$ watts per cubic foot is ample,



Window display of portable heaters.

even for residences, and the manufacturer claims that during the past cold snap when the temperature was ranging around 20 below zero they maintained a large sub-station in Toronto at a temperature of 65 Fah. where the consumption worked out at .93 watts per cubic foot. The accompanying illustration shows the exhibit in the Hydro window. This company also manufacture portable and mantle type luminous radiators.

Are Exclusive Agents

Canadian Allis-Chalmers, Limited, Toronto, have been appointed exclusive agents for Canada and Newfoundland, of the Avery Automatic Scales. The parent factory at Birmington, England, was established almost 200 years ago, and is, we believe, the oldest and largest scale company in the world, comprising factories in England employing 5,000 and another at North Milwaukee, Wis. These scales are of the utmost value in power plant installations for checking the amount of coal and water feed to boilers, in weighing liquids for sugar, oil and other industries, for use in cement plants to determine automatically the proper proportions of the various ingredients, etc. The automatic grain scale is a recognized feature of every modern elevator and mill. The Avery scale in the Canadian Government Elevator at Port Colborne constitutes the largest installation and the largest automatic grain scale in the world.

The St. Lawrence Pulp & Paper Company have awarded a contract to the Canadian General Electric Company for the supply of two 1,000 kw. turbo-generators. The Structural Steel Department of the Canadian Allis-Chalmers, Ltd., will also supply the steel necessary in the erection of the pulp and generating buildings at present under way.

Canadian Felt Products

The Booth Felt Company of Gananoque, Ont., established about a year ago, is now completely equipped to manufacture felt washers, felt gaskets, and indeed every description of felt goods for mechanical and commercial purposes. This plant is practically a duplication of the N. E. Booth plant of Brooklyn, N.Y., established some eight years ago. The management report that business during the opening months of the present year has been exceedingly encouraging and that apparently purchasers are at last appreciating that all their requirements in felt can be purchased without going outside of Canada. The fact that the company have been able to fill all orders promptly has doubtless added greatly to the increase in their business.

A Good Cable Order

The Montreal Light, Heat and Power Company have closed a contract with the Eugene F. Phillips Electrical Works, Limited, Montreal, for the supply of approximately 16 miles of paper insulated lead covered cable. This is the first contract given out by the power company in connection with placing their wires underground under the scheme laid out by the electrical commission of the city of Montreal.

New Companies

The Warman Rural Telephone Company has been incorporated with head office Warman, Sask.

The Northern Ontario Pulp & Development Company has been incorporated; head office Toronto; capital $150,000.

The Mornington & Wellesley Telephone Company, Limited, has been incorporated with head office Millbank, and capital $12,000.

The Canadian Provincial Power Company has been incorporated with head office Truro, N.S. The object of the company is to generate hydro-electric power at Sheet Harbor making use of a fall on the East River. Power will be transmitted and distributed through the counties of Pictou, Colchester, Antigonish, Guysboro and Halifax.

Trade Publications

Mineral Production of Canada—Annual report of the Department of Mines, Ottawa, for the year 1912.

Furnace Efficiency—A handbook entitled "How to Build Up Furnace Efficiency," by Jos. W. Hays; published by the author at Rogers Park, Chicago. Price $1.00.

Inland Waterways of Canada.—The water transportation problem of Canada frankly discussed. Published by the Great Waterways Union of Canada, executive offices Berlin, Ont.

Starting Switch.—Bulletin B-541, January, 1914, issued by the Allen-Bradley Company, Milwaukee, Wis., describing and illustrating their type H Resistance Starting Switch for alternating current induction motors.

Fused Switches.—A folder issued by the Electric Service Supplies Company, illustrating and describing their fused lighting switch. The same company have issued a bulletin describing and illustrating a number of "safety first" signs.

Canadian General Electric—have issued the following publications—Bulletin No. A4190 describing their small motor generator sets, types MIC and MCC; also folder entitled The "Ironclad-Exide" Battery for Electric Vehicles; also pamphlet describing a Trumpet Electric Horn for automobiles. The above publications are well illustrated and describe the various equipment very thoroughly.

Mr. K. Farah, owner of the Charlton-Englehart Company, is prepared to develop High Falls if he is given control.

Current News and Notes

Brantford, Ont.

A by-law will be submitted to the ratepayers on March 23 authorizing the council to sign a purchase agreement for the Grand Valley Railway which calls for the payment of $253,000. The by-law will ask for $270,000 so as to allow of extensions and betterments in the system.

Brandon, Man.

A meeting of representatives of Winnipeg, Portage la Prairie, Brandon and contiguous municipalities was held in Brandon on March 5th at which the matter of obtaining a supply of power from Winnipeg was fully discussed. It is the intention of Portage la Prairie to go ahead with their line this summer and Brandon could be served from Portage. Considerable enthusiasm was shown at the meeting and it looks as if the proposition would result in some actual work being done this year.

Burford, Ont.

The enabling by-law has been carried by this municipality.

Calgary, Alta.

The contract for the current year's supply of meters has been divided among the Canadian General Electric Company, the Canadian Moloney Electric Company, and the Packard Electric Company.

Camrose, B.C.

The electric light rates have been reduced from 18c per kw.h. to 15c. per kw.h. as a result of a surplus for the year 1913 of approximately $2,000 in the operation of the electric light plant.

Chatham, Ont.

The Light & Power Commission have decided to improve their street lighting system during the coming summer by the addition of a number of arc lamps.

Dane, Ont.

La Mine d'or Huronia, E. H. York, general manager, are installing hydro-electric equipment at the present time, the electrical end of which is being supplied by the Canadian Westinghouse Company. The machinery includes one 235 kv.a., a.c., coupled type generator, 3-phase, 60-cycle, 2,200 volt, 360 r.p.m. with belt driven, 10 kw., 125 volt, 1,600 r.p.m. exciter. A transmission line 4,200 ft. long connecting the power house with the mill transmits current at the generated voltage. It is then stepped down to 550 volts for motor operation. The motor equipment in the mill includes two 100 h.p., 3-phase, 60-cycle, 550 volt, 880 r.p.m. induction motors and one 30 h.p., 850 r.p.m. unit. The dam in connection with the power plant is 185 ft. long and 8 ft. high on the average. It is built of square timbers and bolted together with 1 in. Swede iron bolts spaced 4 ft. apart, the timbers being set on bed rock. Between the bolts two drift pins are used and the seams are calked. The joints between the ledge and the bottom of the dam are formed of concrete.

Edmonton, Alta.

The city of Edmonton is purchasing a 6,000 kw. turbo-generator unit. Mr. R. H. Parsons is superintendent of the power plant.

At the annual meeting of the Edmonton Interurban Railway Company a number of extensions were discussed and will likely be made during the coming summer. The most probable extension is a branch line along the north city limits to the Fort trail and on to Fort Saskatchewan.

Englehart, Ont.

Steps are being taken towards the installation of a street lighting system.

Galt, Ont.

The town of Galt have just completed the installation of a fine ornamental lighting system on Oak Street. The wire is underground in conduit. The poles are staggered chiefly on account of the quantity of shade trees on this street. Jandus pressed steel luxolabra, each carrying single tungsten units in spherical globes, are used throughout. This same standard as is now being adapted for the new nitrogen filled lamps. The standards were supplied by Messrs. R. E. T. Pringle.

Halifax, N.S.

The Canadian Provincial Power Company, Limited, have applied for incorporation. It is the intention of this company to develop power at East River, Sheet Harbour, and transmit it to the districts of New Glasgow and Truro. The New Glasgow line will be the principal one as it is the main industrial centre of the province. The main line to New Glasgow will be 48 miles long and at a point 22 miles from the power house a branch 33 miles long will be run out to Truro. At this point there is 16,000 h.p. available twelve hours in the day with almost perfect storage facilities. The plan calls for two power houses three miles apart, the upper under a 95-foot head and the lower under a 105-foot head. The incorporators of the company are H. G. Grant, ex-mayor Underwood, D. C. Sinclair, K. R. McKinnon, O. P. Fraser and W. C. McDonald.

Hedley, B.C.

The Daly Reduction Company, of Hedley, will install a hydro-electric power plant in Hedley. The equipment will consist of a 1500 h.p. water turbine, one waterwheel governor, one 1250 kv.a. generator with switchboard for same. Three miles of wire will be required for distributing system. George McEachern is engineer-in-charge.

London, Ont.

A very enthusiastic meeting of the hydro-electric radial delegates was held in London, on March 5th. The meeting was addressed by a number of the delegates, including Mr. J. W. Lyon, of Guelph, and the Hon. Adam Beck. It was urged that a monster deputation proceed to Ottawa in the very near future to use their influence with the Dominion Government to subsidize hydro railways, and to place the power on the Welland Canal available for their operation. It is likely steps will be taken to this end in the near future.

The 1914 estimates of the London Hydro-electric Commission include expenditures for sub-station equipment, for wires, cable and street lighting fixtures.

Lumsden, Sask.

As a result of an explosion of the compressed air tanks used for starting the engines in the electric plant at Lumsden, the system was out of commission for some time.

Lethbridge, Alta.

It is probable the street railway system will be extended during the present year to Hardieville. A by-law will be

submitted to the rate payers asking authority to make the necessary expenditures.

Moncton, N.B.

Plans are being prepared for a street lighting system.

Montreal, Que.

At the annual meeting of the Cedars Rapids Manufacturing and Power Company, held in Montreal on March 5, the board of directors was re-elected as follows: J. E. Aldred, president; Howard Murray, vice-president; J. S. Norris, secretary-treasurer; J. C. Smith, R. M. Wilson.

The Outremont, P.Q., Council have awarded contracts for cables in connection with the scheme for town lighting designed by Professor L. Herdt. The Eugene F. Phillips Electrical Works, Limited, Montreal, received the contract for the armoured and lead sheathed cable, while the Imperial Wire and Cable Company were awarded the contract for 450 terminals at $7 each.

The Court of King's Bench, Montreal, has dismissed an appeal of the Montreal Tramways Company from the decision of the Quebec Public Utilities Commission ordering them to give details of the working of their company. The contention of the company was that the Commission had no jurisdiction, but the Court held that the Commission had ample powers under the Act.

According to a report from Quebec, an attempt is being made to revive the International Telephone Company, an independent concern organized by local men. Many thousand dollars were expended in constructing conduits and laying cables in the streets of Quebec, but operations were suspended three years ago owing to lack of capital. It is proposed to reorganize the company.

In the official notice confirming the amalgamation of the Northern Electric and Manufacturing Company, Limited, and the Imperial Wire and Cable Company, Limited, under the name of the Northern Electric Company, Limited, the directors state the present managements will be continued, but that there will be centralization with a view to effecting economics in administration. The officers are: Mr. E. F. Sise, president; Mr. Paul F. Sise, vice-president and general manager; Mr. Clement Sare, secretary, and Mr. G. W. Jones, treasurer. The fourth annual Montreal sales conference was held on February 25, 26, and 27, when there were talks and discussions on general sales principles and on specialties handled by the company. On the 27th a dinner was held at the St. Regis Hotel at which many out of town guests were present.

Montreal West, P.Q.

The town council of Montreal West, P.Q., have under consideration a street lighting system.

Ottawa, Ont.

The Ottawa & St. Lawrence Railway Company have made a request for a government subsidy to their railway lines passing the Rifle Ranges.

It is understood that a charter will be applied for, by private interests, to build an electric radial line from London to Grand Bend to Stratford. It is also said that the ultimate plans include Woodstock, Guelph, Galt, Toronto, and St. Catharines. This line would cover much the same territory as some of the lines projected by the municipalities and to be built by the Hydro-electric Power Commission of Ontario.

The past year was a very successful one for the Ottawa Light, Heat and Power Company. At the annual meeting of the shareholders, which was held a few days ago, the financial statement, submitted by the President, Mr. Thomas Ahearn, showed that the gross revenues were $834,662.31, an increase over the previous year of $54,688.97. The net surplus of revenue over expenditures, including bond and bank interest, was $297,766.93. During the year the sum of $808,331.80 was spent from the capital account on additions and improvements to the plants of the Ottawa Electric and Ottawa Gas Companies, the two concerns which form the Ottawa Light, Heat and Power Company. After paying four quarterly dividends at the rate of eight per cent. per annum, with two bonuses of 1 per cent., $90,000 was carried over to the reserve account. The assets of the company are now placed at $5,294,406.87. The following board of directors was re-elected: President, Thomas Ahearn; vice-president, E. H. Bronson; secretary-treasurer, D. R. Street; directors, Travers Lewis, K.C., John Manuel, James Manuel, C. J. McCuaig, Honore Robillard and Warren Y. Soper.

Port Arthur, Ont.

The city will apply to the provincial legislature for power to extend the street railway system into the townships of McIntyre, Gorham and Ware.

Peterborough, Ont.

The plans of the Peterborough Radial Railway System for the present summer include considerable extensions, paving work and increases in the rolling stock.

Regina, Sask.

The operation returns of the municipal street railway system for the week ending February 21 were as follows: Revenue, $4,132; passengers carried, 98,984; passengers carried including transfers, 110,927. For week ending February 28 corresponding figures were $3,951.10; 95,916 and 107,582.

By-laws were submitted on March 11 as follows: $240,000 for completing the construction of the electric light and power plant and the construction of the building in connection therewith and for acquiring necessary additional equipment; $160,000 to be expended in the purchase of a motor-converter, meters, transformers, etc.

Saskatoon, Sask.

A by-law has been passed by the city council giving the city electrical engineer power to insist upon all electric wiring and installations being in accordance with standard rule.

The generating plant of the municipal system has been temporarily out of commission. The street railway system was entirely tied up and the lighting system very much crippled.

The city commissioners have decided that they will not install any more tungsten clusters for street illumination, the modern arcs being considered more satisfactory on account of greater efficiency.

Stellarton, N.S.

An offering of 5 per cent. bonds of the Pictou County Electric Company, Limited, is being made. The Pictou company possesses the right to operate an electric tramway and supply electric energy for light and power in Trenton, New Glasgow, Stellarton, Westville and in any part of Pictou County, N.S. The company now operates ten miles of tramway and supplies light to Trenton, New Glasgow, Westville and Stellarton.

St. Catharines, Ont.

Following the successful conference in London re hydro-radials it is suggested that a similar conference be held with St. Catharines as the place of meeting at which delegates from Lincoln, Welland and Wentworth counties may gather to discuss the same question.

St. Thomas, Ont.

The offer of the London & Lake Erie Railway & Transportation Company to complete extensions from St. Thomas to Aylmer and from Union to Sparta has been accepted by

the interested municipalities who will guarantee the bonds of the company to the extent of $20,000 per mile.

Toronto, Ont.

Construction work has begun on a new factory for the Canada Wire & Cable Company at Leaside.

The Hydro-electric Power Commission of Ontario have lodged a formal protest against the passage of the Bill of the Niagara-Welland Power Company which is asking authority to develop water powers along the new Welland canal.

A large meter contract has been awarded to the Canadian Westinghouse Company by the Ontario Hydro-electric Power Commission. It is the intention to supply municipalities through the Commission, the idea being that a lower rate will be obtained in this way.

The Public Service Commission of New York State have approved the application of the Canadian-American Power Corporation to engage in the business of electric power distribution. This company has available 46,000 h.p. which it has purchased from the Toronto Power Company for export.

Uxbridge, Ont.

The Home Independent Telephone Company will buy out the lines of the Uxbridge and Scott Telephone Company.

Vernon, B.C.

An electric light by-law authorizing the expenditure of $14,000 was recently passed.

Waubaushene, Ont.

The village of Waubaushene have passed a by-law under which they agree to take 25 h.p. of electric energy from the Hydro-electric Power Commission of Ontario. This village is the closest customer to the Big Chute water power development and the rate will thus be very low. Practically the only industries in Waubashene at the present time are the saw-mills and these develop their own power using sawdust and other by-products as fuel. It is very possible that under the rates that can be given with hydro-electric the private plants will be shut down.

Winnipeg, Man.

Contracts have been awarded by the Board of Control for transformers as follows: Single-phase, pole type transformer, Canadian Westinghouse Company; three-phase pole type transformers, Canadian Moloney Company; single-phase and three-phase subway transformers, Mercer & Essex Terminal.

Commissioner Robson will order that all cars to be built in future for the Winnipeg Electric Railway Company must be of the pay-as-you-enter type. Also the company will arrange in future to have their cars stop on the near side of the street.

Westmount, P.Q.

The city council of Westmount, P.Q., have passed a by-law to borrow $250,000 for improving the lighting system and for placing all wires in underground conduits. The city recently installed on Western Avenue 50 6.6 ampere magnetite arc lamps supplied by the Canadian General Electric Company, the system being described in the Electrical News of January 1st. The lighting has proved so satisfactory that an additional 100 standards have been ordered, and these will be placed on Sherbrooke Street and a portion of St. Catharine Street. The sum to be borrowed will enable the council to instal the lights on all residential streets and also to place all the wires underground. Provided the proprietors sanction the by-law, a portion of the work will be carried out this year. The city own the lighting plant, and it is stated that the profits will be sufficient to pay all charges on the bonds to be issued.

Lighting Schedule for April, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Apr. 1	11 10	Apr. 2	5 00	5 50
3	0 00	3	5 00	5 00
4	0 50	4	4 50	4 00
5	1 30	5	4 50	3 20
6	2 00	6	1 50	2 50
7	2 30	7	1 50	2 20
8	No Light	8	No Light	
9	No Light	9	No Light	
10	No Light	10	No Light	
11	7 00	11	10 00	3 00
12	7 00	12	11 20	4 20
13	7 10	14	0 40	5 30
14	7 10	15	1 50	6 40
15	7 10	16	2 40	7 30
16	7 10	17	3 20	8 10
17	7 10	18	3 50	8 40
18	7 10	19	4 30	9 20
19	7 10	20	1 30	9 20
20	7 10	21	4 30	9 20
21	7 10	22	4 30	9 20
22	7 10	23	4 30	9 20
23	7 20	24	1 20	9 00
24	7 20	25	1 20	9 00
25	7 20	26	4 20	9 00
26	7 20	27	1 20	9 00
27	7 20	28	4 20	9 00
28	7 20	29	4 20	9 00
29	10 00	30	4 20	6 20
30	10 50	May 1	4 10	5 20
			Total Hours	179 30

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Town Engineer Wanted

Town of Melville, Saskatchewan

Applications will be received by the undersigned until six p.m., Monday, March 16th, 1914, for the position of engineer for the Town of Melville. Applicants will please give details of experience in sewage installation and other branches of work, and state salary required.

By order,
FRED. H. CLARKSON,
Town Clerk.
5 6

CITY OF REGINA

Sealed tenders, registered and clearly marked on the outside of the envelope, "Tender on Generating or Distributing Equipment for the Electrical Department," and addressed to the City Commissioners at Regina, Saskatchewan, will be received up until noon of March 28th, 1914, for the supply of:—

Generating Equipment

Item 1—Station switchboard consisting of two exciter panels, six generator panels, one totalling panel and sixteen feeder panels.
" 2—Six three phase, feeder regulators.
" 3—One motor-driven exciter, 125 kw.
" 4—One geared turbine-driven exciter, 125 kw., electrical end speed not over 900 r.p.m.

Distributing Equipment

Item 1—Weather-proof copper wire
" 2—Insulators, top pins, etc
" 3—Cross-arms.
" 4—Pole line hardware.
" 5—Cedar poles.
" 6—Pole type transformers.
" 7—Street lighting equipment
" 8—Cut-out mast arms.
" 9—Integrating wattmeters.

Prices to be f.o.b. Regina.

Copy of specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

A marked cheque for 5 per cent. of the amount of tender price to accompany tender.

The City Commissioners reserve the right to reject any or all tenders.

5 6 Superintendent of Light and Power Dept.

Machinery For Sale

Electric Dynamos, transformers and meters for sale:

One 5-kw. transformer (Westinghouse, type N), 60 cycles.
One 5-kw. transformer (Westinghouse, type C), 60 cycles.
Two 5-kw. transformers (Packard, type R), 60 cycles.
Three 5-kw. transformers (Rideau)—60 cycles.
One 5 kw. transformer (Newark), 133 cycles.
One ½-kw. transformer (American), 133 cycles.
All above 2,000 100 volts complete with hangers
Fifty 5-amp. Westinghouse wattmeters (60 or 125 cycles) glass case.
Thirty 5-amp. Gutman wattmeters, 133 cycles.
Six 10-amp. Gutman wattmeters, 133 cycles.
One 20-amp. Gutman wattmeter, 133 cycles.
One 30 kw. S. K. C. Generator, 2-phase, 2,200 volts; complete with exciter and switchboard.
One 30-light Ball arc dynamo with switchboard.

Apply for particulars to W. R. Reynolds, Supt. of Construction, Forest, Ont. 6

Situations Vacant

WANTED—By large Electric Service undertaking in Canada, Sales Manager to take care of business-getting under the General Manager. Apply stating age, experience and salary required to John Mackay & Company, Toronto General Trusts Building, 85 Bay Street, Toronto. 6

WANTED—Qualified accountant to take charge of branch of Accounting Department of large Canadian Electric Service Corporation. Knowledge of the business essential. Liberal salary to good man. Apply in writing, stating age, experience and salary required to John Mackay & Company, Toronto General Trusts Building, 85 Bay Street, Toronto. 6

Situations Wanted

Young man 23, desires position as travelling salesman to some electrical firm. Six years electrical experience, two years road experience, best of references. Box 981, Electrical News. 6

ELECTRICAL ENGINEER

Position Wanted.—Electrical Engineer, expert in erection and repair of a.c. and d.c. power apparatus with good practical experience and graduate of well-known college is open for a position. Can furnish references from well-known Canadian firms as to erections formerly made. Apply Box 982, Electrical News, Toronto. 6

ELECTRICIAN

Young man desires change; unmarried; experience in operating in power and sub-stations, switchboard wiring, motor maintenance and general electric work in light and power stations. First class lineman. Best of references. Box 980, Electrical News, Toronto. 6

Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By
HUGH C. MACLEAN, LIMITED,
HUGH C. MacLEAN, Winnipeg, President.
THOMAS S. YOUNG, General Manager.

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CHICAGO - Tel. Randolph 6018 - 659 Peoples Gas Bldg.
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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, April 1, 1914 No. 7

Canada's Water Powers

On other pages of this issue we print a review of the latest report of the Water Powers Branch of the Canadian Government which deals chiefly with the water falls of western Canada. Two ideas stand out prominently in this report, namely, the steady increase in the total capacity of Canadian water powers in proportion as surveys are carried out by our engineers; and second, the tremendous possibilities of increasing the already large total by proper storage facilities.

This latter looms up as one of our biggest problems of the present century. Apparently it is far too huge an undertaking for private capital. In addition to this the regulation of the flow of any river or any group of rivers in a certain section will have such far-reaching influence that it would seem unfair to expect any private corporation interested in one or two developments only to undertake the regulation of a water flow which may effect favorably a number of other companies. It would appear therefore that it is a government problem and one which must be seriously considered in the not distant future—a systematic survey of the water storage possibilities of the whole Dominion looking to the generation of the greatest possible amount of electric energy and the prosecution of the work of building the necessary dams as our population increases and the demand renders further power necessary. In the interests of economical development it is urgent that as much be known as possible about our various water powers, and much as the government is doing at the present time we are of the opinion that still greater efforts are necessary and that a still larger staff should be employed so that a more minute knowledge of the possibilities of our water powers, great and small, under the most ideal development conditions should be calculated with as great a degree of accuracy as is possible under present conditions of modern engineering practice.

Aluminium Cables

The use of aluminium cable is comparatively a recent introduction in America though it has been practised for some years to some small extent on the European continent.

The objection that is most often heard is that the necessarily larger size of aluminium core, to give it the same carrying capacity, will make the cable uncomfortably large and bundlesome to handle, necessitating larger conduits, etc. The question of cost, however, is the all important one, other things being equal, and it has latterly been shown that, under existing price conditions for copper and aluminium cable, aluminium core can be manufactured for certain voltages and carrying capacities so as to compete with copper cables.

This matter is dealt with in a paper on aluminium insulated cables on other pages of this issue by Mr. E. V. Pannell. Mr. Pannell is thoroughly conversant with the conditions surrounding the relative advantages of aluminium and copper and his paper contains much valuable information on a subject which has been a matter of more than average interest among electrical engineers during the past year or two.

Electrical Section C. S. C. E.

At the meeting of the Electrical section of the Canadian Society of Civil Engineers, held in Montreal on March 20th, four papers on insulators in relation to high tension work were read. Mr. R. M. Wilson presided. The discussion was introduced by Mr. Julian C. Smith, of the Shawinigan Water and Power Company, who referred to the work of hydro-electric engineers in investigating the failures of insulators on transmission lines. There were considerable difficulties in making tests and deteriorations occurred both in the pin head and suspension types. Mr. Smith enumerated causes which led to failures and suggested that the experience of engineers along this line would be valuable. A paper by Mr. J. B. Walls, chief engineer of the Pennsylvania Water and Power Company, gave exhaustive data as to experiments made to ascertain damages caused by lightning. Mr. J. Morse, the chief operating engineer of the Shawinigan Company, spoke of the tests made by that company, which are still being carried out; and Mr. Austin, of the Ohio Brass Company, showed a number of stereoptican views illustrating the various types of insulators and the damage caused by surges. Mr. Austin detailed the causes which led to the failure of insulators under excessive strains, and referred to the means taken to prevent the breakdown of the insulators. There was, he said, a considerable field for further investigations, as they were still in the dark as to all causes of the failure. The manufacture of insulators had been greatly improved, particularly in the matter of glazes, but it sometimes happened that insulators after passing tests, failed from causes practically impossible to detect at that time. Mr. K. B. Thornton, Mr. J. M. Robertson, Mr. J. C. Smith, the chairman, and others took part in a short discussion. The chairman suggested that the operating engineers should get together with the manufacturers, tell them their requirements, and that the makers should find out methods to fill their requirements.

Auxiliary Plant Insurance

The Quebec Telegraph, which was the first newspaper in Canada to instal an individual electric motor plant, has recently installed an auxiliary gas and electric plant, to be protected against any accident to the local electric power.

The new plant consists of a 50 h.p. Crossley gas engine, and Edison generator, which can be set in motion inside of a few minutes. At the present time the mechanical plant of the Telegraph is run by a 50 h.p. Crocker-Wheeler motor-generator set, which receives alternating current from the local company, and transforms it into direct current, which is delivered to over 25 individual motors, throughout the establishment. This electrical installation has been running almost incessantly day and night, for the past five years without a stop, but the management of the Telegraph considered that it was time to give this machinery an over-hauling, and this added to the possibility of an accidental tie up in the service, through accident, at any time, led the Telegraph Printing Company to instal the auxiliary plant. Every machine in the newspaper, job printing, and book-binding departments of the five-storey building of the Quebec Daily Telegraph has an individual electric motor.

Canadian General Electric Annual

The annual report of the Canadian General Electric Company for the year ending December 31st, 1913, has just been made public. Gross profits are $2,029,898, a slight increase over 1912. The net profit is placed at $1,336,339, some $60,000 less than the previous year, the result of a larger allowance for depreciation coupled with bigger interest charges. These net earnings represent about 67 per cent. on the $2,000,000 preferred stock of the company, and, after the preferred dividend has been paid, leaves about 15 per cent. on the $8,000,000 common stock. The report is an unusually good one, especially considering the trade conditions of last year.

George Westinghouse

George Westinghouse, founder of the Westinghouse Electric & Manufacturing Company and allied companies died on Thursday, March 12, of heart disease. Mr. Westinghouse was born at Central Bridge, N.Y., in 1846 and his name for the last forty years has been inseparably connected with a number of the most progressive ideas and far-reaching inventions in the electric world. Among the most important of his inventions is the air brake which has been applied, with modern improvements to railway work of all kinds, both steam and electric. Mr. Westinghouse was also closely associated with the inventions which have led up to the modern railway signal and switching installations.

The Westinghouse Electric Company was formed in 1886 for the manufacture of lamps and electric lighting apparatus. In 1889 the United States Electric Company was absorbed and in 1890 the Consolidated Electric Light Company was added. In 1891 the Westinghouse Electric & Manufacturing Company, which is now known the world over, and employs in its workshops and sales departments over 20,000, was formed.

As indicating the activities of Mr. George Westinghouse it may be noted that he was associated with a large number of electrical companies. He was president and director of Westinghouse Air Brake Company; Westinghouse Machine Company; Nernst Lamp Company; The Union Switch & Signal Company; Societe Anonyme Westinghouse, Paris; Cooper Hewitt Electric Company; Pittsburgh Meter Company; Societe Italiene Westinghouse, Italy; The East Pittsburgh Improvement Company; The Westinghouse Brake Company, Limited, London; Westinghouse Cooper Hewitt Company, London; Westinghouse Friction Draft Gear Company; Westinghouse Metal Filament Lamp Company, Limited, London. He was also chairman of the Board of Directors of Westinghouse Electric Company, Limited, London, and director Westinghouse Electric & Manufacturing Company; The Traction & Power Securities Company, and Westinghouse Metallfaden Gluhlampenfabrik, Vienna.

The Cost of a Small Electric Plant

By Mr. Robert L. Riggs

The town of Strassburg, Saskatchewan, is one of the typical, small Western towns where the lighting problem has been under discussion and solved satisfactorily. About a year ago the ratepayers decided to abolish the old-time acetylene lamps and kerosene oil-lamps, and to have an up-to-date electric lighting station. A by-law was passed by a large majority and the councillors, having called for tenders, decided to purchase a gas producer power plant.

The power house is located conveniently near the railroad track, and is built of brick with a stone foundation, the roof being covered with Carey's prepared roofing material. The gas producing equipment consists of a Ruston Proctor generator and an engine 45 B.h.p. with the usual auxiliary vaporizing and scrubbing apparatus. A self-driven air compressor and receiving tank is provided for starting the engine. The engine is of the horizontal single cylinder, centre crank type, with double ignition system and special type governor for electric lighting duty. The engine is equipped with a flywheel, 8 ft. x 14 in. face, weighing 8,500 pounds.

The cooling water required is 2½ gallons per horse power hour, and four galvanized iron tanks provide circulating water for this purpose.

First Cost of 30 kw. Gas Producer Station*

Real estate, 3 lots at $50 each	$ 150.00
Building	1,812.30
Excavation and building foundations	446.45
Digging well	191.50
Bonds	30.00
Producer, gas engine, tanks, belts and foundations	5,750.00
Generator, 30 kw.; exciter; switchboard; tungsten street lighting equipment; pole line and transformers	4,250.00
Meters, 50	509.00
	$13,139.25

The electrical unit is connected to the engine by a balata belt 45 ft. by 9 in. and consists of a Canadian General Electric alternating current generator, 37½ kv.a., three-phase, 60 cycle, 1200 r.p.m., 2200 volts, and a 2½ kw. belted exciter, 125 volts, d.c.

A two-panel white Italian marble switchboard is installed with the necessary voltmeter, ammeters and instrument transformers. Also the main line oil switch is mounted at the rear. One panel takes care of the distribution system and the other controls the street lighting.

There are twenty-five series tungsten, 100 watt, street lights and the town proposes installing fifteen additional lights. The distribution system is two miles long. No. 8 weather-proof triple braid wire is strung on cedar poles 30 ft. by 6 in. top. These are placed in the lanes, except the poles for the street brackets, which are on the curb line. There are sixty-five connections, the service leads all being connected at the rear of the buildings.

The following pole type, single phase transformers step the voltage down from 2200 to 110 volts for commercial purposes,—one 10 kw. 2200-220/110 volts; two 5 kw. 2200-220/110 volts; three 3 kw. 2200-220/110 volts.

As the citizens desire an all-night service, a rate of 18 cents per kilowatt hour is charged with a minimum of $1.00 a month to cover meter rent. The town is paying $20 a year per light for the street lights and is quite satisfied with the service.

Fixed charges on plant.—

Interest, at 7½ per cent. on first cost	$985.44
Depreciation and obsolescence, 5 per cent.	656.96

* Engineering fees and expenses excepted.

Insurance	100.00
Repairs and renewals, 4 per cent.	525.57
	$2,267.97

Operating Expense per Year—

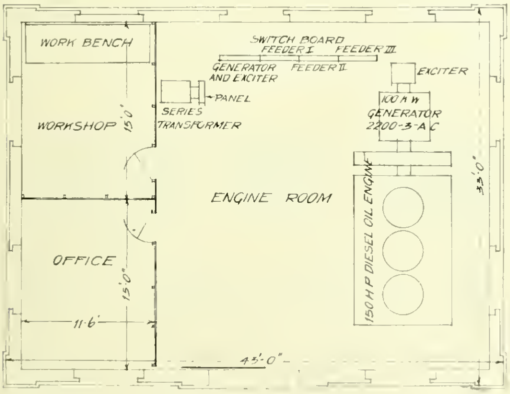
Plant running 12½ hours per day, yearly average,—

Coal anthracite, 90 tons at $8.40	$ 756.00
Operator	1,200.00
Assistant	480.00
Bookkeeper	300.00
Office, miscellaneous expenses	240.00
Oil, waste, etc.	180.00
	$3,156.00
Plus fixed charges on plant	$2,267.97
	$5,423.97

In the producer, Pennsylvania anthracite coal is burned, costing $8.40 per ton delivered in the power house. The analysis of the coal shows 13,289 thermal units per pound. The plant is giving a 16½ hour service, and the revenue per month is steadily increasing. The population served is about 1200.

Diesel Plant in Salmon Arm

Soon after incorporation the council of the city of Salmon Arm took up the question of installing an electric light plant and sewerage and waterworks systems, and commissioned DuCane, Dutcher & Company, consulting engineers, of Vancouver and Calgary, to report on all three schemes. In June, 1912, the engineers reported favorably on a Diesel engine-driven electric plant, and a gravity water system, and also a sewerage system. The report was accepted and steps were at once taken for the installation of all except the sewerage. The power plant consists of a 110 kv.a. Diesel engine plant with direct-connected exciter, a 4-panel switch-



Plan of Salmon Arm new Electric Plant.

board, and a 12 kw. constant current transformer and panel to control the series street lights. The engine is 150 B.h.p. 27.7 r.p.m., three cylinder, vertical type, and was supplied and installed by the Swedish Diesel Company, of Stockholm, who are represented in Vancouver by the E. P. Kay Company, Limited. The generator is 2200 volt, 3-phase, 60-cycle standard type, and was supplied and installed by the Canadian Westinghouse Company. The main leads are 3 conductor, No. 6 B. & S. lead covered in 1½-in. conduit, with potheads. The field and exciter leads are also in conduit. The generator is connected to the engine by a flexible coupling of the usual belt type.

The switchboard consists of one combined generator and exciter panel, and three 3-phase feeder panels. It is of Blue Vermont marble, and presents a fine appearance. A watt hour meter on the generator panel totalizes the station output.

The outgoing lines are temporarily in open wiring, but it is intended to ultimately use lead cable in conduit. At present one 3-phase, 2200 volt line and one 1-phase, 2200 volt line leave the building. The former is for city light and power. Pole type transformers supplied by the Canadian Westinghouse Company connect with the 110 volt secondaries. The mains consist of No. 6 and No. 8 w.p. wire, arranged for best voltages. The other circuit is No. 8 w.p. and has 52 series, 200 watt, Canadian Westinghouse street lamps hung from messenger wires spanning the street.

The building is of brick and was built by Weedon & Talbot, of New Westminster. It is large enough to accommodate another unit of similar size with the necessary extended switchboard. At present this space is occupied by store rooms and operators' quarters, which will ultimately occupy space at the rear of the power house building.

The overhead line work was installed by Mr. W. F. Buchan, local electrical contractor, who put in all station wiring and connections. The usual full load tests were put on the electric plant, and all apparatus proved satisfactory. In October, 1913, the plant was put into commission, and the operation, considering the very light city load, has proved very satisfactory. The engine is very much underloaded, and operates on two of the three cylinders which is a severe condition. The fuel now in use is Star Fuel Oil, and circulating water is obtained from the new waterworks system.

The design and supervision of both electrical and waterworks systems were in charge of DuCane, Dutcher & Company, Mr. W. E. Machan being resident engineer. This firm will also have charge of the sewerage system when it is installed.

New Municipal Plant in Forest

On the 22nd of December, 1913, the old electric light plant, purchased by the town from Messrs. Hamilton & Prout, was closed down, and the new Municipal System put in operation. Although the by-law authorizing the building of the new plant was passed in 1911, construction was not, for vari-

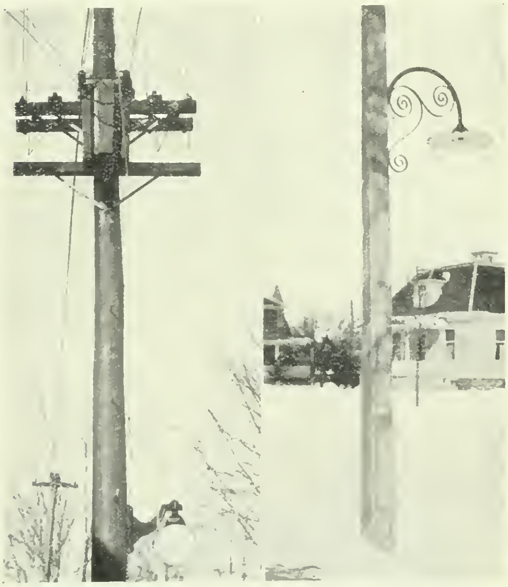
Power House, Forest, Ont.

ous reasons, commenced until the first of September last. The Board of Arbitration fixed the value of the old plant at $1,600. After the payment of the purchase price in May, 1913, the service was continued by the former owners, who received all receipts and assumed all operating expenses.

The new plant, which cost $25,000, is throughout one of

the best example of modern construction to be seen anywhere in a town of like size. The power house is a concrete block building 45 ft. x 45 ft., Fig. 1, and is divided into four parts—boiler room 43 ft. x 22 ft., engine room 20 ft. x 14 ft., pump room 20 ft. x 14 ft., and transformer room 20 ft. x 13 ft. The transformer room is, at present, used as an office, pending the coming of hydro power. The pump room is used for the storing of supplies (the waterworks by-law has not yet been submitted). The chimney is of radial brick construction 90 ft. high and was built by the Alphons Custodis Chimney Company of New York City. The steam plant consists of two Leonard horizontal, tubular boilers, 16 ft. x 60 in. and a Dakin open-feed water heater, 11 ft. by 46 inches. The boiler feed is pumped from an artesian well by a motor driven bulldozer pump to a steel storage tank.

The engine is a Leonard vertical, two crank, high-speed, compound of the enclosed type; forced lubrication; speed 500 r.p.m.; size 10 in. by 15 in. by 8 in., 105 B.h.p.—direct connected to a 70 kw. Westinghouse 2200 v. 3 phase, 25-cycle generator. The switchboard consists of a Westinghouse standard generator panel and one street lighting panel. Two switchboard integrating wattmeters mounted on sub-panels record both total and street lighting loads. The line is exceptionally well designed and constructed. The streets of



Type of overhead work and lighting fixtures, Forest.

the town are lined with trees of such growth that the name of "Forest" is particularly fitting. The primary system is accordingly restricted as much as possible. 2,200 volt wires are carried on 40 ft. poles of Western cedar, painted and stepped. The secondary system is, for the most part, on 24 ft. concrete poles and is in 220 and 110 volt, three-wire group net work. Four point secondary vertical work on the Peirce racks is carried out on all cedar poles. All neutrals are grounded.

The street lighting is in multiple with separate primaries. 120 brackets are so far installed, 40 of the Paris type, with 12 inch opal ball, and 80 of the Brantford type with radial reflectors. The brackets were supplied by Messrs. A. H. Winter Joyner Company. In the business section, the Paris brackets are mounted on every pole, and, at night, the lighting presents a very brilliant appearance. The council has adopted a rule which provides for the installation of extra brackets not on the original plan, when asked for, by the petitioners meeting the cost of the installation, no charge being made for current. This rule has been taken advantage of by the citizens on several streets and Prince, a residential street, in particular, is equipped from end to end with Paris type brackets on every pole.

In order to hasten the development of the plant to a self-sustaining position as rapidly as possible, inside wiring at

Mr. H. J. Pettypiece.

Mr. W. R. Reynolds.

cost has been done from the outset, by a staff of wiremen. This has resulted in almost doubling the number of consumers. At present, the number of users totals 230 and the list is growing daily. All services are metered, at a rate of ten cents per kw.h. net. The service is from dusk to daylight.

The power house equipment was designed by Mr. E. J. Philip, city electrical engineer of Brockville. The construction of the plant was carried out by Mr. W. R. Reynolds, formerly of Ingersoll and St. Mary's, who rebuilt the Orillia redistribution system last year, and the entire work had the careful supervision of a progressive council under the leadership of Mayor H. J. Pettypiece, ex-M.P.P.

Forest is a growing town of 1,500 population situated in the midst of a fruit and agricultural country which is unsurpassed. The new electric light system should prove a valuable asset.

Elapsed Time Recorder

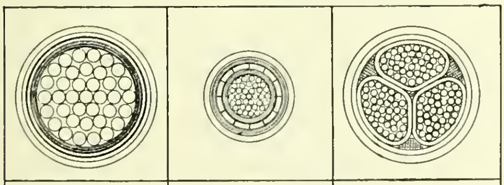
Modern hospitals are demanding that an accurate record be made of the time required for a nurse to answer each call. Only by means of an automatic recording instrument can the superintendent have correct supervision of the attention given to patients at all times of the night and day. For this purpose the Elapsed Time Recorder has been designed by the Holtzer-Cabot Electric Company. This instrument perforates a strip of paper which travels ahead a certain definite distance each minute, thus recording the exact time and the exact number of minutes elapsing between the instant the patient sends the call, and the time it is answered by the nurse. The recorder requires only slight additional wiring, as the same wires which operate the superintendent's annunciator can be used. The paper roll is of sufficient length to give a continuous record of fifteen days, and can be readily renewed in a few seconds. The mechanism is mounted on a heavy, one-piece brass base, and cannot be thrown out of adjustment or fail to work because of moisture, vibration or changes in temperature. The recording pins make a separate hole for each elapsed minute, thus making a clear, permanent record in the paper. The recorder is made in units of twenty-five stations capacity each. As many of these twenty-five station units as desired may be operated from one master clock.

Aluminium vs. Copper Insulated Cables

By Mr. E. V. Pannel*

For several years past the street railway system of Paris has been operating with low tension feeder cables of aluminium. This practice has been attended with very successful results so that considerable extensions which were made to the system in 1913 also utilized aluminium as the conductor, realizing a net economy of about eight per cent. on the cost of copper cables. The cables in question are mainly of the paper-insulated lead covered and armoured type laid in channels under the sidewalk. Developments in this direction in Europe have not been confined to Paris, however, as a paper read by Mr. D'Hoop of the Brussels Street Railway System at the end of 1912 showed that eight different street railway concerns in France, Germany, Switzerland, Belgium and Denmark were using insulated cables of aluminium. In addition to these several English traction and utility corporations have installed underground aluminium cables for almost every type of service. Not only the simple single core cable has been manufactured in aluminium, but double and triple concentrics, also the interesting clover-leaf form of three core conductor for voltages from 600 up to 6600. Quite recently the British Alumnium Company supplied a quantity of the latter at a price which showed a saving over copper, with the heavier metal at a base price of about 17c. A few typical aluminium cables for low and high voltage are shown in Figs. 1 and 2 respectively. These are reproduced merely to show that practically every form of cable has been manufactured in aluminium and that the metal is by no means restricted to heavy low tension cables, although these form by far the larger proportion of the aluminium cables in use.

The test of economy is, however, the true one wherever a new departure is entered upon and it is obvious that aluminium cables can only compete with copper where the relative prices of the two metals make aluminium worth while. Previous to October, 1914, the price of aluminium in this country was not such as to make it a good proposition for insulated cables, except when the copper market was abnormally high. Under present circumstances, however, the light



SINGLE-CORE CABLE	CONCENTRIC CABLE	THREE CORE CABLE
Area cir mils 1650.000	Area: cir mils 2 x 320.000	Area. cir mils 3 x 610.000
Thickness Insulation .118"	Thickness Insulation .10"	Thickness Insulation .125"
" Lead 2 x .06"	" Lead .09"	" Lead .125"
Resin oil between Lead Sheaths Jute and Compound .09"		

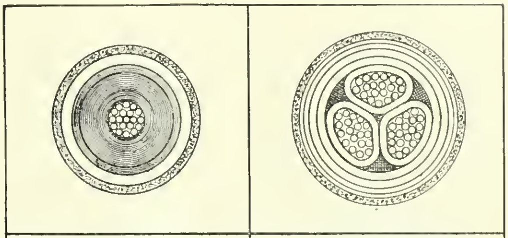
Fig. 1. Low tension, paper-insulated cables, with Aluminium cores.

metal is quoted at prices which show about 25 per cent. advantage over copper, considering the wire base to be about the average figure for the latter metal. During the year 1913 the average monthly price of electrolytic copper wire billets f.o.b. New York was 15½ cents per pound. Allowing a fair differential for rolling and drawing this represents a wire base of 17c. Aluminium wire can be bought at a figure of 24 to 25 cents. Taking the mean of 24½c the relation between the costs of the bare wire will be:

Aluminium, 1 lb. at 24½c	24½c
Copper, 2 lb. at 17c.	34c
Difference	9½c

The above computation makes allowance for the physical properties of the metals. Copper is 3.3 times the weight of aluminium, but the latter has only 60 per cent. conductivity; the ratio of weight for a wire of given resistance per foot is therefore slightly more than two to one in favor of aluminium.

Under the above conditions it remains to be seen to what extent the saving of 9½c will be taken up by the cost



SINGLE-CORE CABLE	THREE-CORE CABLE
Area cir mils 198.000	Area. cir mils 3 x 248 000
Thickness Paper Dielectric .512"	Thickness Paper Dielectric .197"
" Lead Covering .138"	" Lead Covering .118"
" Jute Serving .118"	" Steel-Tape Armoring .120"
	" Jute Serving 090"
Voltage 30.000	Voltage: 6600

Fig. 2. High tension, paper-insulated cables, with Aluminium cores.

of insulating and lead covering the larger diameter aluminium cable. In Fig. 3 is shown the cost of stranding, insulating and lead covering cables for pressures of up to 660 volts. Allowance has been made for material (taking lead at 4c) labor and a reasonable profit. Figuring out a concrete instance—that of a 600,000 c.m. copper cable, we get the following:—

	Copper	Aluminium
Size in c.m.	600000	1000000
No. strands	61	91
Diameter each wire	.099 in.	.105 in.
Diameter core	.893 in.	1.150 in.
Thickness dielectric	.100 in.	.120 in.
Thickness lead	.100 in.	.120 in
Outside diameter	1.293 in.	1.630 in.
Weight core per foot	1.85 lbs.	.925 lbs.
Base price	17c	24½c
Cost core per foot	31.4c	22.7c
Cost insulation and manufacture	16.0c	23.0c
Total cost of cable	47.4c	45.7c

On the aluminium cable in this instance a saving of about $90 per mile is affected. This is, however, considerably less than the economy which frequently results from using aluminium. Larger sizes of cable such as are employed for railway feeders are cheaper to manufacture and show a relatively larger profit in aluminium. The price of copper, too, is by no means always as low as the figure assumed in this calculation, so that according to the market aluminium cables will show a greater or less saving than that indicated above.

*British Aluminium Company, Toronto.

As a writer in the American Metal Market (March 2, 1914, p. 4) has pointed out, the growth of the electrical industries is calling for increased quantities of copper far out of proportion to the production of the metal and unless a substitute be forthcoming there is reason to expect sooner or later considerable advance in the present market quotations for electrolytic metal.

The subject of aluminium and copper cables was admirably dealt with by Mr. B. Welbourn in a paper read before the London Institute of Mining Engineers in June, 1913. His conclusions were based upon extensive experience in the manufacture and supply of aluminium and copper cables and the diagram (Fig. 4) has been reproduced from figures given by Mr. Welbourn. This shows that for a particular size of cable (380,000 cir. mils copper) aluminium begins to be cheaper when the market price is 24½c and at the average figure aluminium cables show 8 per cent. economy. This is for a relatively small size of cable for mining work; larger conductors for railway feeders would show a larger margin.

The foregoing has perhaps sufficed to show that for ordinary low tension paper lead cables, aluminium is a conductor deserving of consideration from the economic standpoint. In the field of extra high tension work, however, the case is different; here aluminium possesses technical advantages. Experience with overhead high tension lines goes to show that there is a ratio of voltage to conductor diameter which cannot be exceeded without giving rise to corona loss. A similar phenomenon takes place with underground cables and aluminium was chosen for the core of the 30,000 volt cable shown in Fig. 2 for this reason. In any

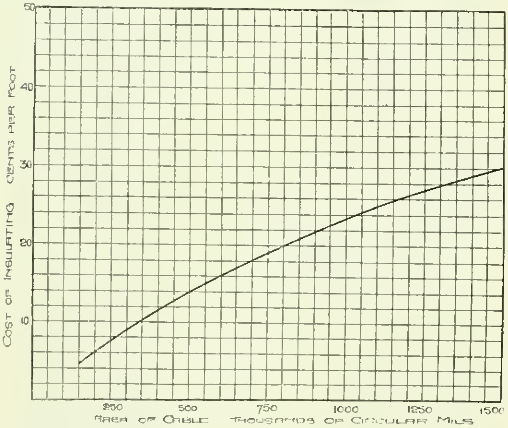


Fig. 3.—Approximate costs for insulating and covering low-tension cables.

high tension cable of this kind the steepness of the potential gradient in the dielectric is given by the formula:

$$\frac{V}{r \log (r + d)/r}$$

where V — effective voltage.
r — radius of core.
d — thickness dielectric.

Naturally if r is increased d may be diminished and the same potential gradient maintained. Aluminium is effective in that it has a value of r which is always 30 per cent. in excess of copper, so that it necessitates less insulation and a correspondingly cheaper cable.

The practical problem in connection with aluminium are mainly those of jointing. No really satisfactory solder being available it becomes necessary to employ clamp joints; the facility with which surfaces of aluminium bite into one another renders these particularly effective, however, and tests made after several years service demonstrate that this type of connection is no more liable to deterioration than a soldered one. The current for some of the most important suburban railroads in the vicinity of Paris is fed through clamp-

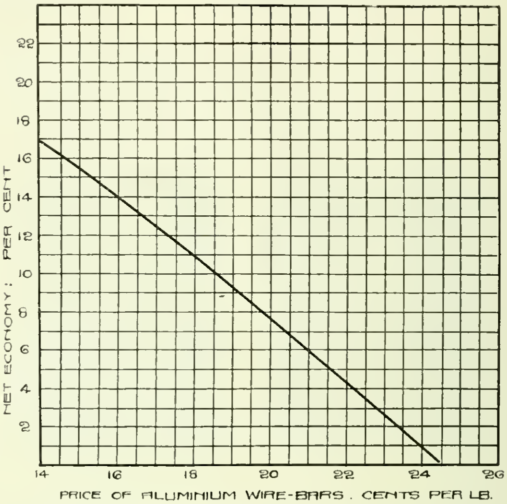


Fig. 4.—Welbourn's values for net saving effected by aluminium paper-insulated lead-covered cables equivalent to 380,000 c.m. copper, assuming the market price of electrolytic copper to be 15.5.

joints of the simplest form with perfect satisfaction. The British Aluminium Company has developed out an improved style of stepped clamp of which a typical pattern is shown in Fig. 5 and this represents one of the most satisfactory

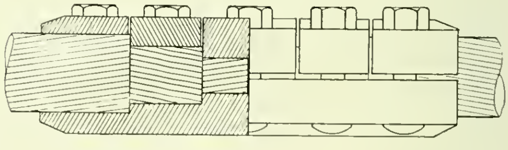


Fig. 5.—Stepped clamp as employed for through joint on Aluminium cables.

forms at present in use. The contact resistance is reduced to the minimum and the size and disposition of the bolts renders the joint a particularly quick and easy one to apply.

Prior to leaving for a three months' trip to Europe, Mr. R. F. Jones, the Montreal manager of the Bell Telephone Company, was presented by the staff with an illuminated address and fitted travelling bag. The presentation was made by Mr. J. A. Anderson and Mr. H. J. Neill at a concert given in honour of Mr. Jones. At the same time presentations were made of the cups donated for competition in the Inter-Department Hockey League. The cup donated by Mr. G. E. Higgins, division plant superintendent, was presented to the maintenance men, while Mr. J. A. Anderson's cup was handed to the ladies' team of the main exchange.

Westinghouse, Church, Kerr and Company, of Montreal and New York, have been retained by the Canadian Pacific Railway Company as engineers to investigate the matter of the proposed electrification of the new double-track, 5½ mile Selkirk Tunnel in British Columbia. The investigations will cover in general the type of system to be installed, the relative economies of steam and water power and the effect of the electrification upon operating conditions.

Steam Prime Movers for Electric Generators

By Mr. G. Percy Cole, M. Sc.

For the conversion of heat into mechanical work, in which the working substance is water and water vapor, various types of steam prime movers have been developed.

Undoubtedly the greatest advance in machines operating through the agency of steam, since the days of James Watt, has been the invention and development of the rotary principle to the production of motive power by means of the steam turbine. The invention of the steam turbine has in fact revolutionized not only marine engine practice, so far as fast vessels are concerned, but has also practically superseded the reciprocating engine for all large units used on land. While of very low efficiency as at first constructed, the steam turbine has been gradually improved until high mechanical efficiencies of conversion have been reached. Especially is the turbine valuable in the production of large outputs and in taking advantage of high degrees of vacuum. Apart from the many desirable features of the steam turbine such as small floor space, low maintenance, etc., the outstanding advantage is the rotary principle. The electric motor, with its one moving element, giving its power in a rotary form, is displacing all types of small engines. The time will come when all stationary motors will be electric, due to the recognition of the advantages of the continuous rotary motion with the uniform angular velocity and resulting simplification.

The various forms of reciprocating steam engine at present in use can only be looked upon as a passing stage in the development; and so soon as an equally efficient machine for any particular purpose is brought out, it must surely displace the reciprocating motor. For proof of this one has only to consider the case of the prime movers for the auxiliaries of any large modern central station. At the present time in large power houses, practically every operation which is not performed by electric motor-driven apparatus is carried out by means of steam turbine outfits. Auxiliaries such as forced-draft fans, boiler feed pumps, condenser circulating and air pumps are developed for steam turbine drive; in some cases direct, in others through the intermediary of gearing. The fact that both the steam turbine and the centrifugal pump are inherently high speed machines, has contributed largely to this application; and the advances in the design of centrifugal pumps in recent years have been such that it is now almost impossible to find a pumping proposition that cannot be economically solved by a steam turbine motor.

While it is well recognized that the market for the reciprocating steam engine is diminishing with each successive inroad of the steam turbine, nevertheless it is still with us; and before considering the steam turbine, the various commercial forms of the reciprocating motor as met with in modern practice will be briefly discussed.

I. "Marine Type," Vertical, Enclosed, Automatic High Speed Engine

The "Marine Type" is probably the simplest form of reciprocating engine met with to-day. It is largely used on steamers and in small plants on land where a low first cost is the prime consideration, and where a high degree of economical operation is not essential. It is usually built for steam pressures of from 70 to 140 pounds, and operates non-condensing. It is only built in small units, from 4 to 35 kilowatts being the usual capacities. The engine is enclosed, and is provided with automatic lubrication. A small flywheel with automatic flywheel governor is always provided; and the sub-base of the engine is extended to receive the generator to which it is connected by means of a flanged coupling. As the capacities are small, and the outfits used only for local lighting, the generators are usually 125 volt, two wire direct current machines.

Fig. 1 gives the investment costs and speeds of a line of such outfits, the figures being for complete set (engine and generator) installed in the vicinity of the large cities of eastern Canada. Figures cover set only, no piping, foundations, cables or switchboard being included.

When operated at normal speed, and at an initial steam pressure of 100 pounds per square inch, the steam consumption in pounds of steam per kilowatt hour at full load will range from 68 lbs. in the smaller capacity to 49 lbs. in the largest unit.

The demand for the "Marine Set" comes largely from the builders of the smaller river steamers, contractors' plants, and plants in small sawmills and factories.

II. Automatic Horizontal Side Crank Reciprocating Engine

This type of engine is still a favorite with many users and is too well known to require any description. It is

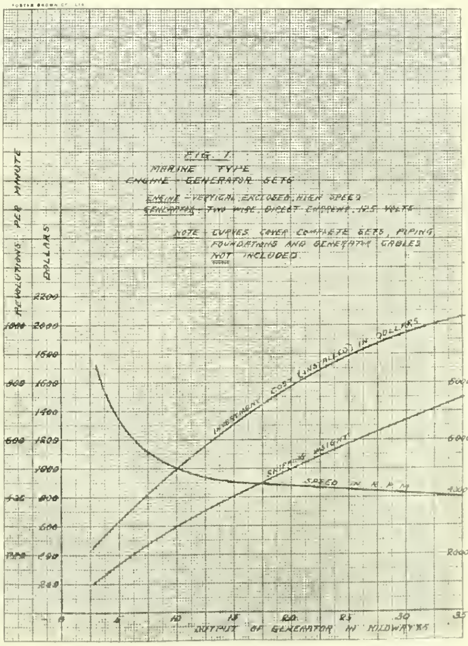


Fig. 1 Marine type engine-generator sets.

very suitable for direct connection to electric generators, has only two bearings, and since the flywheel is placed next the generator, the twisting strains caused by it are not transmitted through the crank. This engine finds its greatest application in capacities of from 35 to 150 kilowatts. It is usually designed for 100 to 150 lbs. steam pressure, and is generally operated non condensing. It is largely used in factories for miscellaneous power and lighting service, and

as the transmission distances are not great, it is usually connected to direct current generators of 125 or 250 volts.

Fig. 2 gives curves of investment costs (installed) and approximate speeds for complete sets of this type, the generators being of the two wire type, either 125 or 250 volts. Very often the generators are of the three-wire 125/250 volt type, which will increase the cost of the set about 7½ per cent.

When operated non-condensing at normal speed, and at an initial steam pressure of 150 lbs. per square inch, the steam consumption in pounds of steam per kilowatt hour at full load will range from 50 lbs. in the 35 kw. size to 42 lbs. in the 150 kw. capacity.

III. Vertical Enclosed Compound High Speed Reciprocating Engine

The so-called "High Speed" vertical engine, as first developed in England, has now been a favorite in Canada for several years. The small floor space required and the smoothness and quietness of its running are among its unique features. When operated condensing as is usually the case, it is very economical in steam consumption. It is built in a large range of capacities, but is generally used in sizes from 100 to 500 kilowatts. While in the smaller sizes the cost of the engine itself is practically the same as the equivalent capacity horizontal side crank engine, on account of the higher speed it enables a much smaller dimensioned (and consequently cheaper) generator to be used. In fact the saving on the cost of the generator due to the higher speed is often the controlling factor in settling on the vertical set instead of the slower speed type.

The vertical high speed enclosed engine, with either direct current or alternating current generator, makes an exceedingly compact outfit, and is largely used in factories and the medium sized steam power plants throughout Canada. On account of the small outside dimensions of these sets, they find a great field in the power plants of large office buildings and public institutions, where the architect rarely leaves sufficient floor space for the plant equipment. Steam pressures from 120 to 150 lbs. are the general rule, and condenser equipment is usually provided.

Fig. 3 gives curves of investment costs (installed) and approximate speeds for a line of engine driven units, including direct current generators of the two-wire type of 125, 250 or 550 volts. Three-wire 125/250 volt generators will add approximately 7½ per cent. to the cost. A line of sets equipped with alternating current generators instead of direct current will not differ greatly from the prices given in the curve of Fig. 3; only it will be necessary to provide for the additional cost of a suitable exciter for the a.c. machine.

The steam consumption, including steam used by auxiliaries, based on 150 lbs. steam pressure, and vacuum of 26-in. referred to 30-in. barometer, for full load operation, will range from 30 lbs. per kilowatt hour for the 100 kw. size to 22 lbs. for the 500 kilowatt capacity.

Vertical high speed engines have been developed above 500 kw., but when these larger capacities are under consideration it will usually be found that the steam turbine will be the logical machine to adopt.

IV. Corliss Slow Speed Reciprocating Engines

As mentioned previously, the demand for the large slow speed reciprocating engine is falling off very considerably of late years. The slow speed necessitates a very large generator, and the massive foundations and large amount of floor space occupied by a unit of this type are among the many disadvantages. It is true that under the stimulation of competition from the steam turbine, there have been important developments in the large reciprocating engine. The developments referred to are found in the engines of the Stumpf and the Lentz designs, and take the form of reduction of clearance and condensation losses. As the low investment cost of steam turbines will be the main factor in preventing the extensive use of these slow speed types of reciprocating engine, they will not be further discussed here.

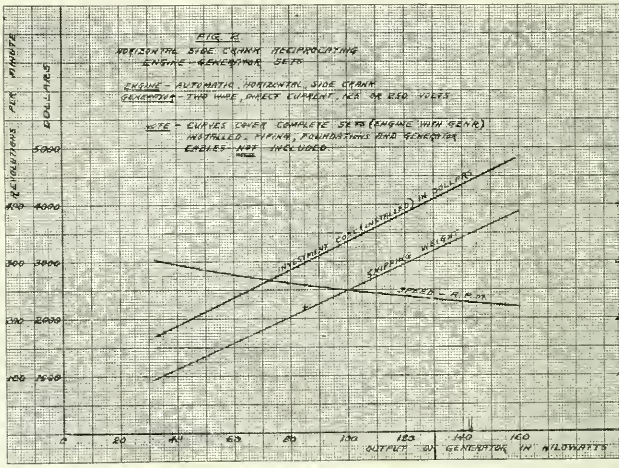


Fig. 2—Horizontal side crank reciprocating engine-generator sets.

V. "Locomobile Type."

A special form of high efficiency combined engine and boiler plant known as the "Locomobile," which has been in use in Europe for several years, has now made its appearance on the American market. It is composed of an internally fired boiler, tandem compound engine, superheater, reheater, feed water heater and pump, with or without condenser, and can be made suitable for direct connection to electric generator through a flexible coupling. The high pressure cylinder is located in the smoke flue and the jacket of the low pressure cylinder forms the steam dome for the boiler; which, together with the use of high superheats and internally fired boiler, results in very good economy of operation. Depending on the quality of fuel, a kilowatt hour can be generated on 1¾ to 2½ lbs. of coal. In this type of engine, it is customary to guarantee the performance of the unit from coal input to power output. In fact, one firm in the United States manufacturing this type of plant gives a $10,000 bond that the low fuel consumption guaranteed by them will be fully met in actual operation.

The sizes range from 75 to 600 horse power (50 to 400 kw.), and since the economy is on a par with gas engine performance, there may be a considerable demand for this class of unit among the smaller power users where a high economy is desired. The "Locomobile" has not made sufficient inroads so far in Canadian practice to allow of figures for investment costs being introduced. The consensus of opinion in the United States seems to be that this new type of prime mover is not making inroads upon any market except that of the reciprocating engine; which market is gen-

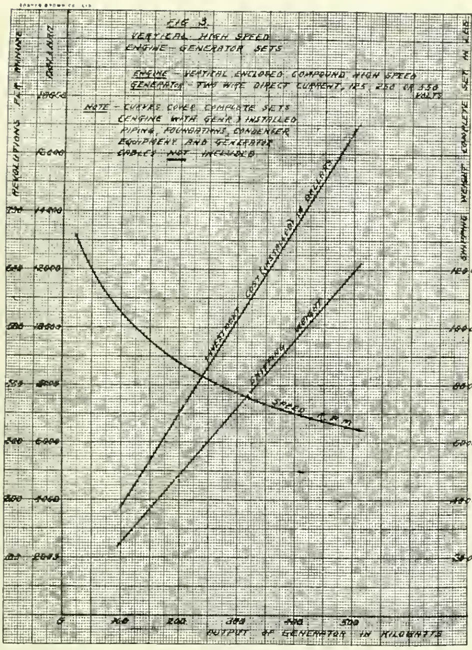


Fig. 3—Vertical high speed engine-generator sets.

erally acknowledged to be growing smaller with each successive year.

VI. Steam Turbines

Steam turbines differ from all other types of steam engine in the fact that their action involves a double transformation of energy. The heat energy present in the steam is first employed to set the steam itself in motion, imparting to it kinetic energy; and this in turn is employed to do work on the turbine blades. In utilizing the kinetic energy of steam in a steam turbine, if the whole heat drop is allowed to give kinetic energy to the steam in one operation, as in the De Laval nozzle, a velocity of about 4,000 feet per second has to be dealt with. To take advantage of a jet in the most efficient manner in a turbine consisting of a single wheel, the velocity of the buckets against which the stream impinges should be nearly one-half the velocity of the stream.

But a peripheral velocity, approaching 2,000 feet per second is impracticable. Aside from the difficulties involved in gearing down to such speed as would allow of the power being utilized there are no materials of construction fitted to withstand the force caused by rotation at such a speed.

Hence it is advantageous to divide the process into stages. This may be accomplished by using more than one wheel to absorb the kinetic energy of the jet, as in the Curtis turbine, or by dividing the heat drop into many steps, making each of these so small that the steam never acquires an inconveniently great velocity, as is done in the Parsons type. Turbines which employ one or other of these two methods, or a combination of both, achieve a greater economy of steam than is practicable with a single wheel.

The use of the single expansion single wheel type of turbine (De Laval) of course involves gearing down before the motion is applied to useful purposes. Heretofore this type has had its greatest field in small capacities; but the recent improvements in the design of double helical gearing to transmit large powers, is bringing this type to the fore in large units. Compared with the Parsons type, it lends itself well to work where small amounts of power are desired; and in such cases tests have shown very good steam economies. A 63 h.p. De Laval turbine used with a condenser has shown an average steam consumption of 20 lbs. per brake-horsepower-hour. In large sizes, however, the Parsons type is much more efficient.

From 500 kilowatts up, the type of turbine that has had its greatest application in this country is the horizontal unit of the reaction (Parsons) type, or the combination impulse and reaction (disc and drum) type. The vertical type has never been a favorite in Canada, and is not being specified for any new stations; the largest firm manufacturing this type in the United States having now developed the horizontal unit.

The following remarks will apply only to the Horizontal, Multiple Expansion, Parallel Full Annular Flow "Reaction" type, or the "Impulse-Reaction" type mentioned above. Practically any output desired can be obtained with this class of turbine. Units of 35,000 kw. normal rating are in successful operation, and 50,000 kw. capacity would be forthcoming if there was a demand for such a unit. The wisdom of adopting a unit of over 50,000 kw. can be questioned; as it would seem to be a case of putting all your eggs into one basket. Turbo-generator units of from 500 to 10,000 kilowatts are the ones usually met with, and in Fig. 4 is given a curve of investment costs in any of the large Canadian cities for sets covering this range of capacities. No piping, foundations or condenser equipment is included in these figures; but figures given include installation. Figures cover generators wound for 2300 volts, 60 cycles, 3-phase. So far in Canada, there has not been much demand for 25 cycle turbo-generator units. Curve of speed shows 1800 r.p.m. for all units above 2500 kw.; and while some firms have built 3600 r.p.m. sets up to 5,000 kw., the curve gives average practice.

High pressure condensing units are usually operated at

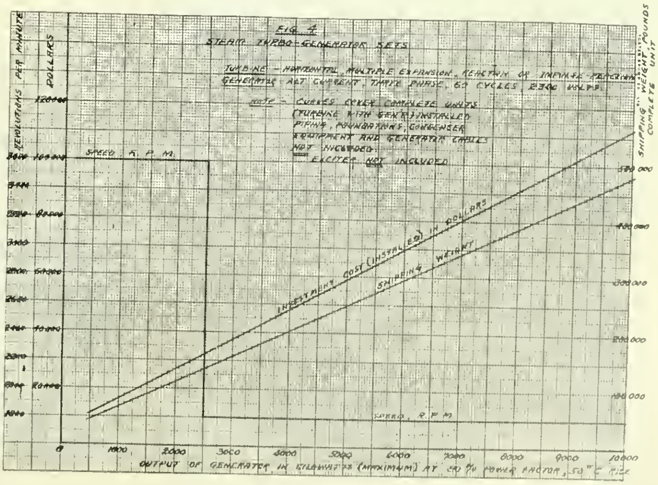


Fig. 4—Steam turbo-generator sets.

steam pressures of from 140 to 200 lbs., and with about 125 degrees of superheat. The vacuum figured on is usually 28-in. referred to 30-in. barometer. With 150 lbs. steam pressure and the above figures of superheat and vacuum, a steam consumption of about 20 lbs. for the 500 kw. size, and about 13 lbs. for the 10,000 kw. unit, may be expected. The above figures are for the rated kilowatt output at 80 per cent. power factor.

The great flexibility of the steam turbine is exemplified in the low pressure, non-condensing and bleeder types. These types are still finding a large market, principally from existing power stations; but a detailed discussion as to the special application of each type is outside the scope of this article.

Pending the developments of the gas turbine and the possible invention of an electro-chemical process of transforming the stores of energy in fuel into electric energy in a single step, the steam turbine still holds the field for all large powers. That the steam turbine has not yet reached its ultimate development, and that improvements are forthcoming, is only to be expected. Leaving aside any discussion on the mixed-vapor turbine, which type of prime mover is now receiving much attention, note should be made of the important improvements in steam turbine economy carried out recently in England by Dr. S. Z. de Ferranti; where a maximum thermal efficiency (efficiency of fuel energy to electric energy) of 29 per cent. is to be expected. When it is remembered that the thermal efficiency of the largest steam turbine units at present in existence is about 17 per cent., we get some idea of the value of Dr. Ferranti's work. The method employed by Dr. Ferranti to improve the economy is by working the steam as a gas at high temperature throughout the turbine. Unfortunately, minute details of this invention are not available; but the following extract is from Dr. Ferranti's remarks in the Watt Anniversary lecture for 1913 at Greenock, Scotland.

"In this turbine I superheat the steam initially, and after the first expansion and whilst it is still superheated, re-superheat it before it does its work in the second stage of the turbine. After this it is exhausted in a superheated condition through a regenerator to the condenser. The whole of the blading is electrically welded so as to avoid the straining due to caulking at the high temperatures that are reached and also the loosening that occurs due to the same cause. The blading is formed of mild steel with a thin coating of pure sheet nickel electrically welded on to the surface. The blading is most accurately finished to shape by a process of step by step pressing under very heavy pressure.

The blading, the sections of which are very exact, is welded in position with the accuracy of the automatic machine that is used for the purpose, and every opportunity is thus given for realizing the best results. Although the turbine is of the reaction type, no balance dummy is used. The whole of the end load is taken on a specially constructed thrust, thus saving steam leakage."

The fact, however, that a 3500 kw. machine of this new type has been running continuously for some time in supplying power to a large works with a consumption of under ten pounds of steam per kilowatt hour, augurs well for Dr. Ferranti's improved turbine.

Hydro - electric Developments in Quebec

The Pont Arnaud Plant of La Societie d'Eclairage et d'Energie Electrique du Saguenay

By Mr. E. F. Bearce, Constructing Engineer

The development of the new hydro-electric station of "La Societe d'Eclairage et d'Energie Electrique du Saguenay," is the starting point of a system which promises to be of considerable interest in the near future. While the present electrical requirements of the town of Chicoutimi are covered by 1500 h.p., plans for extensions to the pulp mills, electrification of railways and new industries call for a load of over 13,000 h.p. inside of the next five years. To meet this demand, "La Societe d'Eclairage et d'Energie Electrique du Saguenay" controls two water powers on the Chicoutimi river which will supply over 13,000 h.p., both powers being a short distance from the town.

The choice of the Pont Arnaud development for the first plant to be built, was governed by its size and ideal natural location for an economical development, being 3½ miles from the mills of the Chicoutimi Pulp Company, and on the main line of the Roberval Saguenay Railway. The other water power, known by the name of "Garneau Falls," situated about 1½ miles above Pont Arnaud, is also of ideal natural location for the economical development of 6600 h.p. in a similar way to the Pont Arnaud plant.

Source and Power of the Chicoutimi River

The Chicoutimi river finds its source in Lake Kenogami, a sheet of water 15 miles in length with a total area of 14½ square miles. This lake also feeds the River au Sable, which supplies the power for pulp and paper mills at Kenogami. To control the water supply to each river timber dams have been built, fitted with regulating gates, and the division of water is fixed by contract between the interested companies so as to send two-thirds of the water into the Chicoutimi River and one-third into the River au Sable.

The maximum flow, at flood, in the Chicoutimi River is 22,000 sec. ft. and the minimum only about 800; plans are made, however, to build a dam at each outlet of the lake which will raise the water level about eight feet more than at present and supply a mean average flow of 1300 second feet to the powers on the Chicoutimi River. Between Lake Kenogami, and the tide water of the Saguenay River, at Chicoutimi, is a distance of 15 miles, and in this distance are six water powers with a total drop of 500 ft. or about 50,000 h.p.

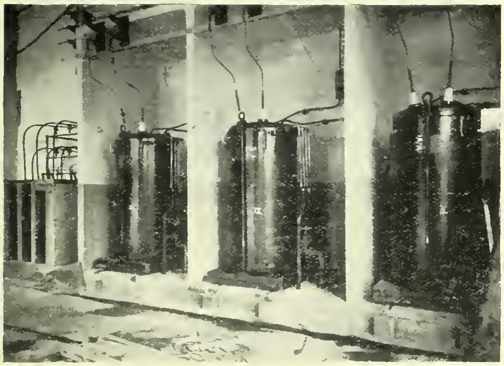
Port Arnaud plant, showing part of dam.

Of this amount, 20,000 h.p. is being used by the Chicoutimi Pulp Company in the manufacture of pulp. The development of the Pont Arnaud plant complete will give 6600 h.p.

The remainder of the power, about 23,000 h.p., is undeveloped, and 20,000 of this amount is within four miles of the town of Chicoutimi, Blanchette Falls with 10,000 h.p. being only two miles distant; the latter is to be developed by the Chicoutimi Pulp Company.

Dam and Forebay

The dam at Pont Arnaud is built of a solid concrete section following a high point of ledge diagonally across the river, with a length of 300 feet. This length is sufficient for a spillway at flood water with the help of a 10-ft. log sluice opening and three 5 x 5 ft. sluice gates. The sluice gates and the log sluice are built into one leg of the rectangular forebay of solid concrete, and the racks and penstock entrances are built in the other leg. All gates are equipped with hand



Step-up transformers at generating station.

operated hoisting apparatus of the worm gear type, so that any of the gates may be operated easily by two men. The penstocks are three in number, each 10 ft. in diameter. No. 1 penstock is installed complete, while No. 2 and No. 3 were provided with thimbles in the forebay and power house; entrances also are set in the concrete bridge under the Roberval Saguenay Railroad which passes over the penstock lines.

Just before entering the wheel case, and inside the power house, surge tanks 7 ft. 6 in. in diameter, one for each penstock, rise ten feet above the elevation of the top of the dam. The design of the surge tank installation is shown in one of the accompanying photographs. As will be seen there, the three larger pipes rise to a common tank which is discharged through two smaller pipes 5 ft. 6 in. in diameter each, connected with the tail race.

The surge pipe and penstock work was supplied and installed by the Petroleum Iron Works, of Sharon, Pa.

Power House

The power house is 105 ft. long, by 75 ft. wide, the foundation and tailrace arches being of solid concrete construction. The superstructure, starting at the generator floor, is built up of hollow concrete blocks, 12-in. wide by 20-in. long. The blocks were made of a 1:4 mixture with the face of a 1:2 mixture, using a white cement to give a greyish white appearance to the finished work. Pilasters of the same block are built around the steel column supporting the steel work of the binding and the top is finished off with a solid concrete cornice giving additional stiffness to the walls. There are two floors in the power house, one for the generator and wheels. The other directly over the wheel cases carries the switchboard and transformer. The roof is covered with Siegwatt concrete beams, which are waterproofed with a standard paper and gravel roofing. At one end of the generator room a boiler room is located and a 15 h.p. upright boiler installed to heat the generator room, surge pipes and racks in cold weather.

Equipment

The power house is complete for all three units except the installation of the equipment of No. 2 and No. 3 units and the penstock connections to the forebay. No. 1 unit consists of a 2200 h.p. S. Morgan Smith horizontal turbine for a 55 ft. head, direct connected to a 1500 kw., 3-phase, 60 cycle, 2200 volt Westinghouse generator with a speed of 277 r.p.m. The exciter unit consists of a 175 h.p. S. Morgan Smith horizontal turbine direct connected to a 125 kw., 125 volt, Westinghouse interpole generator.

The speed regulation of the main unit is controlled by a special type of Lombard Governor. The exciter wheel is equipped with a governor of the same make.

The transformers are three in number rated at $612\frac{1}{2}$ kv.a., stepping the voltage from 2200 to 12,500 for transmission. They are of the oil-filled, water-cooled type and are connected in delta on both high and low tension sides. Each transformer is enclosed in a concrete cell and mounted on trucks and rails so they may be easily moved from place to place on a small car which travels on a track in front of all the cells. The water and oil piping runs underneath the floor, directly under the transformers and are easily disconnected in case a transformer must be moved. The oil drain is connected to a common 3-in. pipe line which leads to an oil tank on the generator floor, large enough to take the oil of two transformers. When it is necessary to drain a transformer, the valve is opened and the oil runs out into the tank by gravity. To refill the transformer, a small hand pump is installed in the pipe line, which is capable of filling the transformer in about 15 minutes. The low tension busbar is made up of 1-in. diameter copper tubing, supported on post insulators mounted on the back wall of the power house, above the transformer cells. Leads are carried through the cell tops to disconnecting switches and then to the low tension side of the transformer. The high tension bus runs

Penstock—one in use, two others in prospect.

near the ceiling along the front of the cells; this is of 4/0 solid copper running the length of the room to the line switch cell and line outlet. All connections are made with Dossert lugs and taps.

The generator switches are located between the first and second banks of transformers and in the same line. These are hand operated oil switches with each pole in a separate cell, and have a capacity of 500 amperes. The leads from the generator are 500,000 c.m. lead covered cables in fibre conduit.

The switchboard for the first installation consists of a panel for the main generator with operating handle for oil

switch, and exciter panel with provisions for a future exciter and a line panel with provision for a future voltage regulator. The switchboard and switch gear was supplied by the Canadian General Electric Company. For lightning protection a set of electrolytic arresters are installed on the generator floor directly beneath the line outlet.

The transmission line follows the right of way of the Roberval Saguenay Railway to the sub-station which is near the property of the Chicoutimi Pulp Company, 3½ miles from the power house. The conductors are 4/0 solid copper designed to carry the full load of the complete installation. All poles are of cedar 35 ft. or more long spaced at 140 ft.

Sub-station

The sub-station is a building 40 ft. x 40 ft. built of granite masonry, the stone used being taken out in excavating for the building. A concrete partition wall divides the station into two rooms, one for the transformers, high tension wiring, and lightning arresters; the other for the switchboard, outgoing line switches and railway generators.

The equipment at the sub-station consists of two Canadian General Electric Company transformers, rated at 937½ kv.a. to step the voltage from 11,800 to 2,200. These two transformers are connected temporarily in open delta with a third compartment to place another transformer and close the delta. Room was also provided to install a second bank of transformers directly opposite the first bank when the installation is completed at the power house. The transformers are placed in concrete cells and have a similar arrangement for connections and oil and water to that in the power house. In this room is also installed a 12,000 volt electrolytic lightning arrester and a 300 amperes, 15,000 volt line oil switch in a concrete cell.

The other room of the station contains two 300 kw. motor-generator sets, which supply power for the Roberval Saguenay Railway. These machines are made up of a 425 h.p., 2200 volt, 3-phase, 60-cycle, squirrel cage induction motor direct connected to a 550 volt, compound, interpole railway generator rated at 300 kw. and running at 870 r.p.m.

Surge tank arrangement at power-house.

In connection with these machines, are two motor panels with 2200 volt, starting switches and auto-transformers, two direct current generator panels and two feeder panels. The generator and feeder panels are provided with ammeters and a volt meter; a Thomson recording watt-hour meter measures the power delivered by each machine. The power from these two machines is used to operate two electric locomotives which do the shifting in the pulp mill yard, and carry a passenger service to the main line of the railroad One of these locomotives has been in service fifteen years. It weighs 25 tons and is operated by four motors with an old rating of 75 h.p. This locomotive was supplied by the Canadian General Electric Company. The other locomotive, bought in 1912, has a total weight of 35 tons, and is operated by four motors rated at 60 h.p., built by the Westinghouse Company.

Besides the railway generators, there are in the same room three 500 amp., 2200 volts, 3-phase, oil switches and outgoing lines to the pulp mill motors and two 100 amperes, 2200 volt, 3-phase, lines to supply the town lighting and power. The output of the mill feeders is measured by a

Mr. Xavier Ouellet.

Mr. J. G. Moquin.

curve drawing wattmeter for each line, mounted on a panel beside the railway feeder panels. The oil switches are mounted on pipe and angle iron framework, which also supports disconnecting switches and a small panel for the operating handle and trip coils.

The switchboard and switch gear for the sub-station and for the power house was supplied by the Canadian General Electric Company and the motor and generator sets in the sub-station were built by the Canadian Westinghouse Co.

The Chicoutimi Pulp Company has a connected load of about 850 h.p., including alternating and direct current motors of 10 to 575 h.p. The direct current motors are a part of the old system at the mill operating at 550 volts from the trolley service. These are all small motors running conveyors, wood saws and construction machinery. The alternating current equipment consists of one 575 h.p. C. G. E. Co. 2200 volt, 3-phase wound motor running at 257 r.p m. and operating pumps, screens and auxiliary machinery in the two mills.

A 150 h.p., C. G. E. Co., 2200 volt, 3-phase, 60-cycle, 720 r.p.m. induction motor operates cutting-up mill and a 50 h.p. motor runs the machine shop.

The power requirements of the town at present are for about 9,000 lamps of all kinds and 125 h.p. in motors for the several industries.

The demand for electrical energy, both at the pulp mill and in town, is constantly increasing and the electric company will soon be obliged to install the second unit at Pont Arnaud, and several motors at the mill.

The design and construction of the Pont Arnaud plant was in charge of Mr. H. S. Ferguson, consulting engineer, of New York City. Mr. J. E. A. Dubuc is president, Mr. J. G. Moquin is manager, and Mr. X. Ouellet is superintendent of the company.

The annual report of the American Telephone & Telegraph Company which is synonymous with the Bell Telephone Company of the United States shows that the number of subscribers added during the past year was 676,943 and that the total number of subscribers is now 8,133,017. The gross revenue in 1913, not including connected independent companies, was $215,600,000.

The Water Powers of Western Canada

Volume 2 of the annual report of the Department of the Interior for the year ending March 31, 1913, is just to hand. This includes information on irrigation and on the water powers capable of development at various points in Canada. The report is submitted by Mr. J. B. Challies, C. E., Superintendent of the Water Power Branch of the Department of the Interior and contains much matter of interest to the electrical and hydro-electric engineer.

The report covers, for the most part, water powers in Manitoba, Saskatchewan and Alberta, these provinces including that section of Canada concerning which least is known about the water falls. There is also appended reports which have been submitted to Mr. Challies by individual engineers on the work submitted to their charge. These include references of considerable length to the small water powers of the West, by Mr. A. M. Beale, B.Sc.; to the field organization and general work carried on under the jurisdiction of the Water Powers Branch during the past year, by Mr. J. T. Johnson, B.A.Sc.; to the Manitoba hydrographic survey, by Mr. D. L. McLean; to the B. C. railway belt hydrographic survey, by Mr. P. A. Carson; to the investigation on the Bow River district, by Mr. M. C. Hendry, B.A.Sc.; to the construction of the Coquitlam dam, by Mr. R. S. Stronach; to the La Colle falls hydro-electric development by Mr. E. B. Patterson; to the Cascade River power development by Mr. C. H. Mitchell, C.E.; to the Saskatchewan River between Le Pas and Cross Lake, by Mr. T. H. Dunn, C.E., and to the South Saskatchewan River as a source of water supply for cities and towns in South Saskatchewan, by Mr. H. E. M. Kensit.

A General Review

Mr. Challies reviews the situation in a general way and points out the policy of his department with regard to the conservation and development of the water powers under their jurisdiction. Extracts from his report follow:—

"The extensive water-power investigations on the Bow river, commenced in 1911, with M. C. Hendry, B.A.Sc., engineer-in-charge, have been practically completed, and it is confidently expected that a full report of same will be ready for publication during this year. The general results of these investigations, as outlined in Mr. Hendry's report—Part No. 7 hereto—are surprisingly gratifying, showing that it is economically feasible to so regulate the flowage of the Bow river as to warrant the development at five power sites of over 45,000 continuous 24-hour wheel horse-power, all within a thirty mile reach of the Bow river and not more than fifty miles from the city of Calgary. The results of these investigations are an unanswerable argument in favor of similar investigations being carried on by competent experienced power engineers under proper expert advice. It is hoped that the results of these Bow river investigations and their value to the public will allow closer working co-operation to be effected with the irrigation engineers in similar investigations that may be made on Alberta streams, valuable for both irrigation and power purposes. The water-power engineers solicit and welcome the fullest co-operation of the irrigation engineers—their basic aims are identical and can only be properly and fully realized by co-operation. The present use and distribution, and the conservation of the water resources of the Bow river basin constitute one of the most important problems before this department. In some of its branches this problem has already been solved, while in others it still awaits solution, although a beginning has been made and the lines of progress have been marked out. The Bow river water seems so abundant that many persons do not reflect upon its importance, or the actual limits of the supply, yet this is of the utmost moment, for upon it depends the agricultural and commercial prosperity of a very large area of southern Alberta. Every one is familiar with the wonders that have been worked in this district by irrigation—miles of desert area, almost destitute of vegetation and incapable of adequately supporting human or animal life, have been converted by water from the Bow river into fertile tracts, producing an abundance of cereals and vegetables of all kinds. This has been due alone to the magic power of water, and to obtain it tremendous labour and many millions of dollars have been expended. With the growth of industrial activity the waters of this same river have also been called upon to supply energy for transmission, many miles away, to the city of Calgary, for municipal purposes, including street lighting, tramways, etc. At the first blush, it would appear as if these two important uses of water—for irrigation and for power—would result in a serious conflict of interests, but fortunately the irrigation requirements occur during a period that the river is in flood and storage on the upper waters of the Bow river will make it possible to conserve enough of the flood waters not required for irrigation to equalize the low flow during the winter months that may be required for power purposes."

"The extensive power and storage investigations of the Winnipeg river have made considerable progress, but will not be completed for another year. The results of these investigations to date (as briefly outlined in Mr. Johnston's report, herewith) show that at six power sites on the Winnipeg river, within the province of Manitoba, over 239,000 24-hour continuous wheel horse-power can be developed, and with full regulation of the river (easily and cheaply accomplished by the Norman dam at the outlet of the Lake of the Woods and by a dam at the outlet of Lac Seul) at least 500,300 horse-power of continuous 24-hour power can be developed. Surely this spells an assured industrial future for the city of Winnipeg and the province of Manitoba."

"The policy of this department with regard to the conservation and development of the water-powers under its jurisdiction in Manitoba, Saskatchewan, Alberta, the Railway Belt of British Columbia and the Northwest Territory, has been of gradual growth, although each step has led in the same general direction—actual development without delay, control of rates to be charged consumers of power, and a rental for the use of the power, with the right to revise same. As water-powers are valuable because of their strategic position, as well as because of the flow and fall of the water, and as their adequate development generally means a very large expenditure, the means whereby the priority of right to any given power is established is a very important feature of any regulations concerning them. In this connection the principle is laid down that mere priority of application does not establish priority of right. Priority is only secured when an agreement under the water-power regulations has been entered into between the Department and the applicant for the development of the power. The agreement provides for the development of a minimum amount of power within a fixed period, not exceeding five years, for the expenditure of a stated amount of money on actual developments operations in each year, and for the issuance of a license covering the necessary amount of water and a lease for the necessary Dominion land upon the fulfillment of the terms of the agreement, the lease and license to be concurrent and for a term of twenty-one years, renewable for three further consecutive periods of twenty-one years each, and subject to cancellation

upon non-fulfilment of the terms of the lease and license.

Under the present water-power regulations it has been extremely difficult to deal with applications for the development of small power projects, but regulations will shortly be in force covering small water-powers of less capacity than 200 horse-power, and it is proposed to have an experienced practical engineer make a full personal investigation of each application for the right to develop these small power schemes, with a view to rendering such engineering assistance and advice as may be possible. Most of these are projected by settlers and small mill owners, with a view to developing sufficient power to run a grist-mill or saw-mill, or for general lighting and farm purposes. In view of the practical adaptation in Ontario and the state of New York, of electricity for general labour-saving devices around the farm and for small manufacturing purposes, it would surely be a direct and lasting benefit if proper practical advice and experience were made available by the Government in connection with the many small projects throughout the West which are before this department for authorization. To meet the situation, Mr. A. M. Beale, B.Sc., an engineer of this branch has been delegated to give this matter his special study and attention. Mr. Beale will, wherever practicable, inspect each application, and where necessary will give the applicant every possible assistance in having the project carried out in a satisfactory way."

Small Water Powers

Mr. Beale's report deals with the development of small water powers having a capacity of 200 h.p. or less. It is suggested that as few obstacles as possible should be placed in the way of the development, by interested parties, of these small water-falls. It is also suggested that the form of water wheel best adapted for this size of the plant is the overshot wheel. In this connection the following extract from his report will be of interest:—

"Small water-powers merit considerably more attention than has been accorded to them in this country. In Great Britain the water-driven mill is to be seen on every hand in the country districts, flour and feed mills, saw-mills, pin-mills and so forth, furnish a local industry for the supply of local wants. In Canada the conditions are vastly different, but in Eastern Canada and the United States, where conditions approximate more nearly to those of the western provinces these small power sources are receiving attention.

It is of interest to mention here that the form of water-motor most used in England for small power purposes is the overshot wheel. This wheel is shown by Mr. C. R. Weidner of the University of Wisconsin, to be peculiarly suitable for small powers on this continent, ranging in head from 10 to 40 feet and from 2 to 30 second feet in discharge, that is to say, up to 75 horse-power. These wheels, though nearly twice as costly as turbines of the same power, have the advantage of high efficiency, reliability, adaptability to varying discharge, simplicity in construction, setting and operation, all of which compensate for an increased initial cost; further, ice troubles experienced with this form of wheel are less severe. For the development of small powers, and especially for driving slow speed machinery, the overshot wheel is worthy of attention."

The Bow River

The most troublesome characteristic of the rivers which have their source in the Western mountain range is the irregularity of their flow. For example, the Bow river has a flow as high as 45,000 second feet and as low as 500 second feet. The importance of regulation is therefore immediately evident and all the more so as the main power section of this river is within easy transmission distance of Calgary the leading city of that district. According to Mr. Hendry's report there are six considerable falls on the Bow river the most remote of which is 43 miles from Calgary. These vary in height from 44 to 70 feet and their capacities under unregulated and regulated flow are given in the accompanying table. Under proper regulation it is anticipated that the average flow could be raised to at least 1500 second feet. The first two of the falls are controlled and developed by the Calgary Power Company.

Power Site	Continuous Wheel Horse power	
	Natural Flow	Regulated Flow
1 Kananaskis falls	3,820	9,545
2 Horseshoe falls	3,280	9,545
3 Bow Fort	3,600	9,000
4 Mission	2,565	6,410
5 Ghost	3,780	7,270
6 Radnor	2,800	6,400
Total	19,785	48,170

Another water fall discussed in this report by Mr. Hendry is Rock Rapids on the Saskatchewan about 75 miles west of Edmonton. As with the Bow river the greatest difficulty is with the irregularity of the discharge, which on the Saskatchewan river is known to vary between 88,000 second feet and 1546 second feet. The minimum discharge is placed at 6400 h.p. which would not justify the necessary expenditure in view of the power situation in the Edmonton district.

Among the other falls reported on by Mr. Hendry was Grand Rapids on the Athabasca. On this river the discharge varies from 110,000 second feet to 2,500. Under a 45 foot head the maximum continuous output would therefore be about 10,000 h.p. which can be increased to 30,000 under regulation conditions. The market for this power is not evident, however, as Edmonton, the closest large city, is 200 miles distant.

Cascade River Development

Mr. Mitchell's report dealt with the project for a small hydro-electric power development on the Cascade river, at the outlet of Lake Minnewanka. The water of this lake is being stored by the Calgary Power Company but arrangements were made between this company and the Dominion Government which allows the use of sufficient water by the government to develop nearly 1,000 h.p. which it is intended should be used for government purposes in the Rocky Mountains Park at Banff. The scheme of development is outlined at some length and figures are given both of cost and operation.

South Saskatchewan Water Supply

Mr. Kensit's report deals primarily with the use of the South Saskatchewan river to supply water to the various towns and cities in the south Saskatchewan district. An interesting part of the report deals with the most economical method of pumping this water. Three sources of power are available, namely, hydro-electric power to be developed in the neighborhood, power purchased from some operating company, or, power developed by fuel such as coal, crude oil or gas. Relative figures of cost under the conditions existing in that district are given on the following types of plant—high duty pumping engines; steam turbines (coal), centrifugal pumps; steam turbines (natural gas) and centrifugal pumps; water-power with steam reserve; water-power, no steam reserve; producer gas; purchased power; Diesel oil engines. The relative merits of the different plans vary, of course, with the quantity of water to be pumped and it is therefore almost impossible to come to any general conclusion from the figures submitted.

An interesting phase of the power situation was discussed by Mr. Kensit and figures given covering the relative cost of electric transmission and the cost of hauling equivalent coal. As this also only applies to the particular case considered, its general application is not definitely determined. It would appear from the figures, however, that where less than 70,000,000 gallons per day were required to be

pumped the cost of carrying fuel is less than the cost of electric transmission. Where the requirements are in excess of this number of gallons the cost of electric transmission is considerably less.

Northern Manitoba

In his report on the Nelson river district Mr. Johnson takes occasion to point out the value of more definite information than is at present available regarding the water powers of northern Manitoba. With reference to the Nelson river he writes as follows:—

"The enormous resources of the Nelson river form the natural power storehouse of northern Manitoba. This river receives the run-off of the Winnipeg, Red, Saskatchewan, and innumerable smaller rivers; the whole run-off is equalized by the three large lakes, Winnipeg, Winnipegosis and Manitoba; the drop of 710 feet from Lake Winnipeg to Hudson Bay, over a series of falls and rapids, offers an enormous source of power for this district. The rapid opening up of the country due to the building of the Hudson Bay railroad will soon bring these powers within the range of commercial development, and it would be advisable that an investigation of the river be kept in view. The Churchill river farther to the north also offers a great field for power development."

Mr. Johnson's report also speaks at some length on the value of the Lake of the Woods as a storage basin. Though it is true that the Winnipeg river in its natural condition is one of the best regulated rivers on the continent it has been shown recently that the actual gaugings vary between 12,000 second feet and 52,700 second feet. Under properly regulated storage conditions a uniform flow of 20,000 and possibly 25,000 second feet could be obtained which would increase the capacity of the river from approximately 25,000 to nearly 50,000 h.p. Mr. Johnson's report covers at some length the two existing plants on the Winnipeg river, namely, that of the city of Winnipeg and that of the Winnipeg Street Railway Company. The other five principal falls are also described and their relative capacities with unregulated flow, partially regulated flow and maximum regulation given as in the table herewith:—

Site	Head	Unregulated flow of 12,000 second feet minimum	Regulated flow of 12,000 second feet.	Maximum regulation of 25,000 second feet
*City of Winnipeg municipal plant	48'	52,300	87,300	100,000
Slave falls	26'	28,400	47,400	59,000
*Winnipeg Street Railway plant .	39'	42,500	42,500	42,500
Seven Sisters (say)	40'	.....	29,100	47,400
McArthur	20'	21,800	36,300	45,400
Du Bonnet	48'	52,000	87,000	109,000
Pine	43'	47,000	78,200	98,000
		244,000	407,800	511,300

*Existing power plants.

Mr. McLean also emphasized the importance of the regulation of the Lake of the Woods and in this connection writes:—

"By proper regulation of this lake the powers on the Winnipeg river would be increased some 55 per cent., or from some 276,000 horse-power to 422,000 horse-power marketable power. This would be of great benefit to: The city of Winnipeg's Municipal Power plant, to the Winnipeg Street Railway Company's plant, to the large water-powers owned by the Dominion Government, to the Ontario Government water-powers, to the town of Kenora, to the Keewatin Power Company and to the Lake of the Woods Milling Company."

The Shawinigan Water and Power Company are issuing $1,375,000 new stock at the price of $120 per share.

Underground Telephone Cables

Underground telephone cable systems were described in a paper read by Mr. G. A. Moore, supervisor of plant, Bell Telephone Company, at a meeting of the Montreal Electrical Society on March 2nd. Mr. Moore outlined the development of the system of aerial construction, from the grounded system to the present metallic circuit system, and recounted the disadvantages which led to the use, in cities and towns, of conduits. The latter were of two kinds—the solid and the built-in, the latter being almost universal in Canada for telephone purposes. Mr. Moore also described the development of conduits, from the days when lumber was used to the present fibre duct and vitrified clay conduits. A single duct up to 9 ducts was used, although the latter was unusual. After a reference to the classes of insulated wire employed, Mr. Moore spoke of the methods of drawing in wires, and the troubles in ducts, such as ice-squeezes, burn-outs, and electrolysis. For long distance work special cables were made, although it was found that for this communication better results were obtained from aerial lines than from conduits. In Montreal about 80 per cent. of the wire used by the Bell Company for outside communication was underground. There were underground wires on 77 miles of streets, including ten miles of laterals. There were 64 towns in Canada where the company have constructed conduits. One conduit in Montreal is 10½ miles long, while another almost encircles Mount Royal. The conduits of the company were separate from those being put down by the city.

In 1913 the gross earnings of the Bell Telephone Company of Canada were $8,850,448, an increase of $1,212,144, while the net earnings of $2,215,257 were $335,072 higher and the balance available for dividend $1,793,522, a gain of $195,427. After paying a dividend of 8 per cent. there is a surplus of $503,732. The total assets are $39,798,851, an increase of $8,111,244. In the report, Mr. C. F. Sise, the president, stated that 30,918 subscribers were added during the year, the total number of telephones now in use being 223,666. The company own and operate 452 exchanges, an apparent decrease of 4 (caused by the consolidation of certain exchanges). 7,977 miles of wire were added to the long distance system in 1913. The long distance lines now owned and operated by the company comprise 72,063 miles of wire on 9,276 miles of poles, and 3,019 miles of wires in underground and submarine cables. The company have arrangements for exchange of business with 531 local organizations, serving over 65,179 subscribers. A substantial part of the company's earnings is derived from investments of the shareholders' funds, and from the use of surpluses year by year in extending and improving the operating telephone plant of the company, and the net revenue for 1913 was 6.2 per cent. upon the total investment.

The company own 223,666 stations, an increase of 30,918, while the number of connecting and miscellaneous stations is 65,562, an addition of 10,225 during the past year. The number of miles of wire is 622,548, the central stations 452, and the number of employees 8,270. The average daily exchange connections in 1913 were 1,739,388, and long distance 17,169

The following statements show the growth of the company in five year periods:

Year	Exchanges	Number of Subscribers	Wire, in Miles	Distance Pole Miles
1885	126	10,200	3,000	2,000
1890	212	20,437	8,288	4,071
1895	345	30,908	11,851	5,881
1900 . ..	343	40,094	21,350	6,525
1905 .. .	526	82,351	37,082	8,645
1910	508	138,370	54,133	8,861
1913	452	223,666	75,082	9,276

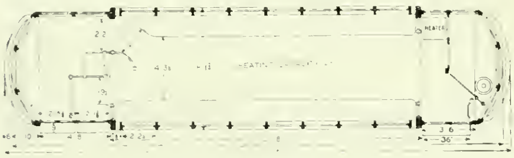
Electric Railways

Single-Truck Cars for Windsor, Ontario

An order for steel underframe, vestibule, pay-as-you-enter cars was recently completed by the G. C. Kuhlman Car Company for the Sandwich, Windsor & Amherstburg Railway, Windsor, Ontario. The cars are intended for one-way operation and are mounted on Brill No. 21-E trucks.

The side sills are formed of steel plates, 14 in. by 3-16 in. These are reinforced at the top by a 4-in. dropper bar and at the bottom, along the outside edge, by a 3-in. by 2½-in. by ⅜-in. angle which carries a 2-in. by 4-in. yellow pine sill into which the ash posts are tenoned. Additional longitudinal members are made up of channels and T-sections. The end sills are formed of 9-in. channels and the crossings consist of 5-in. channels. The platforms are supported on two center knees formed of 5-in. channels and outside knees of 4-in. channels shaped like a truss.

The roof is of the monitor deck type, with pivoted ventilator sash; side windows have double sashes, those



Plan of new Windsor cars.

at the top being stationary, while the bottom ones are arranged to drop into pockets. The interior is finished in cherry, with longitudinal seats upholstered in olive-green leather. These have rounded corners at each end, with pipe stanchions at the forward end. A heater is provided on the controller side of the front platform and is separated from the motorman's position by a partition, the upper part of which is panelled in glass.

Vestibules are of the round end type, with double sash windows similar in operation to those in the car body, except for an adjustable feature on the center window at each end. The vestibules are panelled inside with sheet steel, which is cut away at the bottom to permit cleaning the window pockets.

The rear vestibule is provided with double folding doors, each section having two leaves and being arranged to open inward. These doors are operated in conjunction with folding steps by means of a mechanism controlled from the conductor's position, the latter being guarded by pipe railings as shown in the diagram.

Hamilton Incline Railway Extensions

East End Incline at Hamilton is to be supplied with important new electrical equipment. Mr. Geo. F. Webb has given the order for this equipment, as follows, one special double fixed drum, double geared electric Lidgerwood Incline hoist; two C. G. E. 180 h.p., 550 volt, d.c. motors with special automatic control; one C. G. E. motor-generator set; one "Tudor" storage battery of 262 F. 11 cells, and one C. G. E. four-panel switchboard.

The Safety First Movement

One of the most important developments of the past two years, both in steam and electric railway work, is the Safety First movement. It has come to be recognized that fatalities are due to causes which, in many cases, are under the control of the operators, and an educational campaign has been launched in both the United States and Canada which is already having far reaching results in reducing the number of accidents.

It is true that the human factor is not the only one to be considered; much is also being done along the line of safety appliances of all sorts such as, for example, the more general use of air brakes, the use of more reliable material in the construction of machinery and in the methods employed by the men in the discharge of their duties. It is generally recognized, however, that the education of the men themselves towards a more careful and vigilant discharge of their duties is the most important feature to be reckoned with and is the line along which the greatest improvement can be made in the least time.

Nor must it be forgotten that in this educational campaign the only people who need education are not the operators themselves. The general public, and this is especially true of electric railway work, are very largely responsible for many of the accidents. It follows therefore, that a campaign of education must follow somewhat different lines on steam and electric railways. The maxim to be followed by the operators in each case, however, is the same—eternal vigilance and caution. This phase of the question was discussed in a very interesting way in a recent address by Mr. A. T. Hardin, vice-president of the New York Central lines before a New York Central line safety meeting. Mr. Hardin spoke on different phases of the safety movement, but regarding the men themselves the following remarks are of unusual interest. The New York Central goes so far as to publish a monthly magazine devoted to a discussion of this Safety First movement, of which some 80,000 copies are printed each issue and distributed among their employees. An extract from Mr. Hardin's remarks follows:—

The fourth and last element in this Safety analysis, and the most important of all, is the man element. Man, in some cases is the most certain, and in other cases the most uncertain element, with which we have to deal, and therefore involves the greatest hazard and the largest field for Safety work. This is true because we are dealing with human nature, with its many unknown racial and family traits. The railroad rank and file, as to-day constituted, probably has the best body of men of any commercial enterprise in the world. But men do not remain stationary. The service is constantly being depleted through retirement; through natural causes, such as death and illness; through changes in occupation, and through many other causes. This makes it necessary to employ annually on the New York Central lines from 5,000 to

10,000 new men. The railroads can examine these young men to see that they have the proper physique to enter the service, and can make reasonable inquiry as to their antecedents, their character and the influences at home which may tend to control them in the future. The railroad can also instruct them in the several books of rules and regulations and can exercise to a limited extent only a general watchfulness over them in groups, after employment. But, as a rule, after they have passed the awkward squad, so to speak, and entered the ranks of the railroad army of 150,000 men, the identity of many of these young men at first becomes almost entirely lost. If then a young man have a good foundation for truthfulness, honesty and for the well-recognized traits which count for honor, and if he have somewhere in him that indefinable spark of conscience, which always points out his duty, and tells him to do it; or, even if he have not all of these with him at first, but has a good railroader with him on the engine, in the caboose, in the stations or on the tracks or elsewhere, he will soon make, and will probably remain, a good railroad man, and therefore the safest element in our wonderful transportation organism. If, on the other hand, a man have concealed in him bad traits of character and have bad instructors and bad associates, he is liable to become a bad man and then more dangerous than the rottenest rail that was ever rolled.

We have among us thousands of men whose type illustrates what we mean by "Safe men." The best of them sometimes make a mistake, because it is human to err, but it is the high average of efficiency which counts. I need mention only a few specific cases to explain what I mean. The Empire State Express has run to date over six million miles, or around the world two hundred and fifty times. During that period I cannot find where an engineman or a conductor or one of their crews has been guilty of sufficient neglect of duty to have jeopardized the Safety of the passengers who had entrusted themselves to their care. The names of these men, and many others in the service who belong to a similar honor roll, are so well known to you that they need not be mentioned here. We all know what they stand for; namely, service and duty well done, which means Safety. We venture the belief that hundreds of men who have served under these men were taught their lessons and are giving a good account of themselves.

Now, these honor roll men and others like them, are not mere accidents. They have learned their profession from the careful men who preceded them, and then in turn must make the next generation of railroad men by the same process. The extent to which this is done, and the extent to which we continue it, is the measure of the degree of Safety which we shall attain. If this be true—and I think I am not mistaken—we have reached the real meaning and the ultimate significance of this so-called "Safety First" movement. We cannot escape the conclusion, nor in the end the responsibility, that we are and must be with these young men "Our Brother's Keeper."

Will Make Large Expenditures

Following out the policy of improving the system, in order to meet public requirements, the Montreal Tramways Company have decided to expend about $2,000,000 during the coming season. Last year many parts of the track were relaid and new intersections put in. The present programme includes the renewal of a large mileage, the erection of two car barns, and the purchase of 100 double truck cars. The new rails will be 116 lbs. to the yard in place of the 80 lb. rails. It is intended to gradually substitute the new trailer cars for the single type on the St. Catherine street route, the trailers having proved both popular and efficient in dealing with the heavy traffic. Two new routes are to be opened up. The company will appeal to the Privy Council against the decision of the Appeals Court, Montreal, that the Quebec Public Utilities Commission has jurisdiction over the company. The latter deny the right of the Commission to order the production of certain documents relating to the operation of the company.

Personal

Mr. H. Doughty, Superintendent of the Regina municipal street railway system has resigned, the resignation to take effect on May 1, 1914.

Mr. D. W. Houston, assistant superintendent of the Regina municipal street railway system has been appointed acting superintendent.

Mr. A. K. Bunnell will, it is understood, be acting superintendent of the Brantford Street Railway system for the remainder of the year 1914.

Mr. Charles F. Gray has been appointed consulting electrical engineer to the Manitoba Rolling Mills Company, Limited, particularly in regard to the electrical equipment for their new plant at Selkirk.

Mr. J. B. Woodyatt for many years power superintendent of the Sherbrooke Railway, Light & Power Company has resigned to accept a position with the Southern Canada Power Company in Montreal.

Mr. F. A. Gaby, chief engineer of the Hydro-electric Power Commission of Ontario delivered an address on March 21 before the Canadian Institute, Toronto, on the subject of "The Hydro-electric System."

Mr. H. D. Johnson has resigned his position with the Canadian British Insulated Company to join the engineering staff of the Eugene F. Phillips Electrical Works as assistant contracting manager. Mr. Johnson is considered one of the best authorities on underground distribution in the Dominion and is thus a valuable acquisition to the company he is joining.

Mr. C. Antony Ablett.

Mr. C. A. Ablett, who was recently appointed general manager of the Siemens Company of Canada, Limited, has had a wide experience as an electrical engineer in Europe and the North American continent. Previous to his present position, Mr. Ablett was manager of the steel works and rolling mill department of Messrs. Siemens Brothers Dynamo Works, Limited, London, England, and had charge of the installation of some of the largest electrical plants in European steel works. Prior to 1906, he was with the G. E. Company and was engaged in electrical work in Canada and the United States. Mr. Ablett has contributed papers to the Institution of Civil Engineers, the Iron and Steel Institute, and the Institution of Electrical Engineers, and was joint author with Mr. H. M. Lyons of a paper on the "Electrical Driving of Winding Engines and Rolling Mills," read March 12 before the Canadian Society of Civil Engineers and the Canadian Mining Institute. This is a subject on which Mr. Ablett speaks with special authority as, we understand, he has installed some 60 winding plants in various parts of the world. He is an associate member of the Institution of Civil Engineers, and has been awarded the Bayliss and Miller prizes of that Institution.

Illumination

Efficiency of Illuminants

By Dr. Charles P. Steinmetz[*]

When considering problems of illumination, whether it be lighting of indoor places, or of the streets of a city, the first and most important question is the efficiency of the source of light, or the illuminant.

Efficiency is not the only factor, but other features come in as essentials of a satisfactory illumination, such as:

The quality or color of the light; that is, how nearly white it is, or whether it is off color towards the yellow or the green.

The size of the lighting unit, as determining uniformity and diffusion of the illumination.

The glare or absence of glare of the illuminant; that is, the intrinsic brilliancy of the light source.

The steadiness of the light, and its sensitivity to fluctuation of voltage or current.

The characteristic of the electric circuit required for the operation, as determining the amount of station apparatus, such as constant current transformers, voltage regulators, etc.

The cost of maintenance and renewal, such as trimming, length of life of the arc lamp electrodes, useful life of the incandescent lamps, etc.

However, all this is secondary to efficiency, because defects in any of the above enumerated features can be overcome by a sacrifice of efficiency:

While a light source which is free of glare would be preferable even if of slightly lower efficiency, its inferiority in efficiency must not be much, as a light source can be freed of glare with a slight decrease of efficiency, by a diffusing globe.

Higher cost of maintenance and renewal balance against lower cost of power in the more efficient illuminant, etc.

Thus, while the other features of a satisfactory economical illuminant must be considered and balanced against light efficiency, the efficiency is economically the dominating factor.

In judging of the efficiency of light sources, two procedures are feasible:

We may secure and photometrically test all the commercially available illuminants, and base our judgment thereon. This would be the proper and only feasible way in solving an illuminating engineering problem, as when designing the illumination for a building, store, streets of a city, etc.

Such procedure would fail, however, when considering the larger problem of the development of the art of illumination, and of the possibilities of the various illuminants, as when dealing with the question whether the new high efficiency incandescent lamp will replace the arc lamp or whether the arc lamp as well as the incandescent lamp will find definite fields of usefulness. Questions of this character can not be decided by the comparison of existing types of lamps, as these types merely represent the industrial requirements of the preceding years, and a general judgment on the possibilities of the various illuminants would almost certainly be erroneous and misleading, if based only on existing commercial types. It would for instance not include the effect of the gas-filled mazda lamp or of the titanium lamp, neither of which is yet a standard commercial product.

Thus, in judging on the possibilities of the various types of illuminants, we must go beyond the mere comparison of existing commercial lamps, and must base our judgment on the efficiency characteristics of the light giving radiator—lamp filament or arc stream—as derived from the photometric tests of lamps in commercial existence or in development.

In comparing light efficiencies, only the total light flux given by the source of light can be considered, and will in the following be given in mean spherical candle-powers (msph. c-p.), as the mean spherical candle-power is a more familiar unit than the lumen (one lumen $= 4\pi$ msph. c-p.).

The candle-power 10 deg. below the horizontal, which is of importance in street lighting, and the mean hemispherical candle-power, which is of importance in indoor lighting, are not measures of the light flux of the illuminant, and have no direct relation to efficiency, but they represent the distribution of the light flux as affected by the type of reflector, globe, etc. Comparisons based on 10 deg. c-p. or mean hemispherical c-p. characterize just as much the efficiency of the design of globe or reflector as the light flux, and thus when used in the efficiency comparison of light production, would be misleading. For instance, a European quartz mercury lamp gives 10 deg. below the horizontal the same c-p. per watt as the mazda lamp, but gives four times the mean hemispherical candle-power of the mazda lamp: its total light flux, however, or its msph. c-p. per watt, are only twice that of the mazda lamp. By a suitable reflector, the mean hemispherical c-p. of the same mazda lamp could be increased by 50 per cent. or by another reflector the 10 deg. c-p. of the mercury lamp made more than twice that of the mazda lamp, etc. Thus, depending on the reflector used, we would get all kinds of comparisons of these two lamps, when using 10 deg. or mean hemi-spherical c.p. No reflector, however, can change the total light flux, or the msph. c-p. of the light giving source, and with the same light flux and equally good design of reflector, the 10 deg. c-p. and the mean hemispherical c-p. would be closely the same also, so that the total light flux is the characteristic of the illuminant which best determines its efficiency for all uses.

Table 1. gives a collection of efficiency data of the various available illuminants.

The fourth column gives the msph. c-p. per watt of commercial lamps, as based on photometric tests. Therefrom, and from other tests, are derived in column 1 the specific consumption in watts per msph. c-p., and in column 2 the efficiency in msph. c-p. per watt, of the light source proper, that is, the filament, arc or vapor stream. The values in column 2 usually are higher than those in column 4, by the amount of light which in the commercial lamp is lost in reflectors, obstructed (in the arc lamp) by the operating me-

*Chief Consulting Engineer, General Electric Company.

Table I. Light Sources

Type of Lamp	— Radiator — Specific consumption watts per mean sph. c-p.	Efficiency; mean sph. c-p. per watt	Available Efficiency; mean sph. c-p. per watt (inclusive reflector*)	—— Lamps —— Mean sph. c-p. per watt	Mean hemisph. c-p. per watt	10° c-p. per watt
Incandescent Lamps						
Treated carbon fil., 3.1 watt hor. c-p.	3.9	0.26	0.21	0.26	0.4	0.4
Metallized carbon fil. (Gem) 2.5 watt hor. c-p. ...	3.1	0.32	0.26	0.32	0.5	0.5
Mazda, 1 watt p. hor. c-p.	1.25	0.80	0.64	0.80	1.2	1.25
Gas-filled mazda, 0.5 watt p. hor. c-p.	0.625	1.60	1.28	(1.60)	2.4	2.5
Melting tungsten in vacuum	0.28	3.6	(2.88)			
Enclosed Carbon Arc Lamps						
6.6 amp., 450 watt, a-c. series	2.0	0.50	0.39	0.4	(0.7)	0.5
6.6 amp., 480 watt, d-c. series	1.25	0.80	0.62	0.6	(0.9)	1.0
500 watt, d-c. "intensified" arc	1.00	1.00	0.78	0.8	1.4	
Flame Carbon Arc Lamps						
Best values of 500 watt yellow flame	0.25	4.0	3.1	3	5.6	6.2
Best values of 300 watt yellow flame	0.4	2.5	1.95	2	3.5	4
Best values of 500 watt white flame	0.4	2.5	1.95	2	3.5	4
Magnetite Arc Lamps, d-c.						
Standard 4 amp. 300 watt 250 hour	0.77	1.3	1.0	1.0		2.2
Special 4 amp. 300 watt 150 hour	0.56	1.8	1.4	1.4		3.0
Standard 6.6 amp. 500 watt 100 hour	0.53	1.9	1.5	1.5		3.2
Special 6.6 amp. 500 watt 100 hour	0.46	2.2	1.7	1.7		3.5
Titanium Arc Lamps, a-c.						
Standard 200 watt	0.42	2.4	1.9	1.8		4.0
Experimental 350 watt	0.29	3.5	2.7	(2.6)		5.1
Experimental 500 watt	0.22	4.6	3.6	(3.5)		7.0
Best values	0.15	6.7	(5.2)			
Mecury Lamps						
Best values, glass tube	0.5	2.0	1.55			
Best values, quartz tube	0.4	2.5	2			
Moore Light						
Best values, nitrogen	1.8	0.56	0.45			
Best values, neon	0.7	1.45	1.1			

*Loss by reflector assumed 20 per cent. for incandescent, 22 per cent. for arc lamps.

chanism, etc. The efficiencies given in column 2 can in general not be realized, since in directing the light flux for the distribution required by the use of illuminants—downwards in indoor lighting, and with a maximum about 10 deg. below the horizontal in street lighting—a loss of light occurs in reflectors, globes, etc. This loss is assumed equal to 20 per cent. in the incandescent lamps, and 22 per cent. in the arc lamps. These values represent about average conditions met with properly designed light distributors. Column 3 then gives the available efficiency, that is, the efficiency of the light flux directed for the contemplated use, or the "useful light flux" available with suitable reflector, etc. Columns 5 and 6 give the mean hemispherical candle-power—indoor lighting—and the candle-power 10 deg. below the horizontal—street lighting—of the lamp per watt, as given by test or estimated as available with suitable reflector, etc.

It is obvious that general efficiency comparisons of the various classes of illuminants must be based on the values in column 3, as these values represent the usefully available light flux in msph. c-p. per watt. All the following tables, except where otherwise stated, are therefore based on the values in column 3 of Table I.

A difficulty exists in comparing flame carbon arcs with each other and with other illuminants, insofar as flame carbons have no typical efficiency, but their efficiency depends on the amount of impregnation. With increasing impregnation, the efficiency increases, but other defects make themselves gradually more and more felt, as slagging and sticking, etching of the glassware, lesser steadiness, etc. In the tables are given the best values found in test, though commercial flame carbons of different types and makes are as a rule lower by from 20 to 50 per cent.

Table II. gives the relative efficiency of the various illuminants of Table I., arranged in the order of their efficiency, from the least efficient to the most efficient, irrespective of the size of the illuminant.

The limitation of this table naturally is, that the efficiency of illuminants varies with the size, or watt consumption, in a different manner for different illuminants. Thus the efficiency of incandescent lamps remains approximately constant over a wide range of sizes, while that of arc lamps increases with increasing, and decreases with decreasing watt consumption. A smaller unit of arc lamp would therefore take a lower position, and a larger unit a higher position in the table.

Table II. Relative Efficiency of Illuminants

(Irrespective of size, in available mean sph. c-p. per watt)

3.1 watt per h. c-p. carbon filament	0.21	0.4	Any
2.5 watt per h. c.p. gem filament	0.26	0.5	Any
450 watt 6.6 amp. series enclosed a-c. carbon arc	0.39	0.5	175
Nitrogen Moore tube	0.45		
480 watt 6.6 amp. series enclosed d-c. carbon arc	0.62	1.0	300
1 watt per h. c p. mazda lamp	0.64	1.25	Any
500 watt d-c. "intensified" carbon arc	0.78		
4 amp. 300 watt d-c. standard magnetite arc ...	1.0	2.2	300
Neon Moore tube	1.1		
0.5 watt per h. c-p. gas filled mazda lamp	1.28	2.5	above 350
4 amp. 300 watt d-c. special magnetite arc	1.4	3.0	(420)
6.6 amp. 500 watt d-c. standard magnetite arc ..	1.5	3.2	750
Mercury lamp in glass tube, best values	1.55		
6.6 amp. 500 watt d-c. special magnetite arc ...	1.7	3.6	850
220 watt a-c. titanium arc	1.9	4.0	420
300 watt yellow flame arc, best values	1.95	4.0	[585]
500 watt white flame arc, best values	1.95	4.0	[975]
Mercury lamp in quartz tube, best values	2.0		
Experimental 350 watt a c. titanium arc	2.7	5.4	(950)
Melting tungsten in vacuum	2.88		
500 watt yellow flame arc, best values	3.1	6.2	[1550]
Experimental 500 watt a-c. titanium arc	3.6	7.0	(1800)
Titanium arc, best values (high power)	5.2		

As 300 watts and 500 watts are representative power

consumption of medium and of large light units, in Table III. and Table IV. are given the efficiencies of available 300 and 500 watt illuminants, in order of their efficiency, from the lowest to the highest.

Table III. Efficiency of 300 watt Illuminants

	Available mean sph. c-p. per watt	Available mean sph. c-p.
Mazda lamp (1 watt per h. c-p.)	0.64	190
Standard 4 amp. d-c. magnetite arc	1.0	300
White flame carbon arc, best	1.2	360
Gas-filled mazda lamp (0.5 watt per h. c-p.).	1.28	384
Special 4 amp. d-c. magnetite arc	1.4	420
Yellow flame carbon arc, best	1.95	585
A-c. titanium arc	2.4	720

Table V. then gives comparison of the watt consumption of the different types of illuminants required to produce respectively 200, 300, 400, 500 and 1,000 available msph. c-p. The values in this table are also arranged in order from the lowest efficiency, that is, the highest watt consumption, to the highest efficiency, that is, lowest watt consumption.

Many interesting conclusions can be drawn from these tables.

For instance, in Table V., 400 c-p. seems about the dividing line between high efficiency and low efficiency illuminants: The a.c. and the d.c. arc and the mazda lamp do not go beyond 400 c-p., while the flame carbon arcs, the titanium lamp and the gas-filled mazda lamp do not go below 400 c-p., and can not be produced efficiently in smaller units.

Table IV. Efficiency of 500 Watt Illuminants

	Available mean sph. c-p. per watt	Available mean sph. c-p.
A-c series enclosed carbon arc	0.42	210
Mazda lamp (1 watt per h. c-p.)	0.64	320
D-c. series enclosed carbon arc	0.65	325
Gas-filled mazda lamp (0.5 watt per h. c-p.) .	1.28	640
Standard 6.6 amp. d-c. magnetite arc	1.5	750
Special 6.6 amp. d-c. magnetite arc	1.7	850
White flame carbon arc, best	1.95	975
Quartz mercury lamp	2.0	1000
Yellow flame carbon arc, best	3.1	1550
A-c. titanium arc	3.6	1800

It is interesting to note that the 6.6 amp. a-c. series enclosed carbon arc lamp, which has done practically all street lighting of America for many years, and has done it fairly satisfactorily, and which is still to-day the most widely used street illuminant throughout the country, does not even reach 200 c-p., but, as seen from Table II., gives only 175 available msph. c-p. About 400 c-p., or more than twice as much, is the lowest c-p. at which the gas-filled mazda lamp can be efficiently built (300 watts), while the 300 watt 4 amp. magnetite arc, which has been most successful in replacing the carbon arc in street lighting, gives an available 300 c-p., and the lowest titanium arc unit, of 220 watts, gives about 400 c-p. From this, it seems that the smallest units at which these high efficiency illuminants can be built are the industrially most important ones in street illumination, and even these are rather larger candle-powers than necessary for general street illumination in towns and cities. There is a general desire for more light, but more still is the desire for cheaper lighting, and there is a much greater appreciation of getting a reasonable increase of illumination—50 to 100 per cent.—at a reduced cost to the city, than there is of getting much more light at the same price; while even a very great increase of light, if accompanied by an increased cost, is rarely acceptable in street lighting, except in special cases of decorative lighting, of white way lighting, etc., and such special application naturally represents only a small part of the country's lighting. This is well illustrated by the experience of the arc lighting industry: when the arc lighting engineers became so interested in "large units" as to lose some interest in the low power high efficiency arcs and began to push the big luminous or flame arcs, the replacement of the 175 c-p. enclosed carbon arc by low power luminous arcs, which had been going on rapidly before, practically stopped, and the country turned to the mazda lamp, which offered lower power and therefore cheaper units.

Table V. Relative Efficiency of Various c.p. of Illuminants

(Watts per mean sph. c.p. in sizes indicated)

	200 c.p.	300 c.p.	400 c.p.	500 c.p.	1000 c.p.
A.c. carbon	490	620			
D.c carbon	380	480			
Mazda	310	470	620		
Standard magnetite		300	350	400	700
Special magnetite		(250)	290	350	550
Gas-filled mazda			310	390	730
Titanium			210	250	360
White flame				350	520
Yellow flame				280	406

Very interesting is the appearance, in the gas-filled mazda lamp, of the first incandescent lamp with an efficiency within the range of the modern arcs; as seen, more particularly in Table II., there is a considerable number of illuminants with efficiencies of one to one and a half candles per watt, which may be classed as "medium efficiency illuminants." The gas-filled mazda lamp falls in this group, between the different sizes and efficiencies of the magnetite arc; and cost of maintenance and replacement, quality or color of the light, etc., then become factors in the selection between these illuminants.

The group of illuminants below one candle per watt, comprising the various carbon arcs and vacuum incandescent lamps, is hardly of much further industrial value in street illumination, while on the other hand, in the yellow flame arc and in the titanium arc, efficiencies can be reached which no incandescent lamp can ever approach, and the latter illuminants, within their field of application, therefore still remain unrivaled in efficiency.

Tungstolier Company Absorbed

The business of the Tungstolier Company of Canada has been taken over by the Canadian General Electric Company, Limited. It is the intention to carry in stock a large assortment of electric fixtures for both commercial and residential lighting, and the C. G. E. Co., being equipped with an up-to-date fixture factory, will be able to give an excellent service. Communications regarding fixtures and glassware should be addressed to the Canadian General Electric Company, Limited, Fixture Section, Toronto, or to their nearest district office.

Owing to increasing demand for power, the Canadian Light and Power Company have decided on additions to the equipment at their plant at St. Timothee. The company have placed an order with the I. P. Morris Company, Philadelphia, for a 7,200 h.p. turbine operating under a head of 48 feet at a speed of 150 r.p.m. The turbine is of the horizontal shaft twin volute casing type, the contract including an I. P. Morris governor. A contract has also been closed with the Canadian General Electric Company for a 5,000 kv.a., 3-phase, 2,300 volt, 60-cycle, 150 r.p.m. generator. The Canadian Crocker Wheeler, Limited, will supply a 5,000 kv.a., three-phase, 2300/48000 volt, step up transformer.

The Dealer and Contractor

A Modern Theatre Switchboard

The illustration of the switchboard herewith shows one of two installations recently completed in Loew's new theatre, Yonge Street, Toronto. This photograph is of the board which controls the lights in the upper theatre. A corresponding board, though somewhat larger, controls the lower theatre. As will be noted, the board is divided into three panels. The left hand panel controls the lights on the stage, the middle panel the lights in the body of the theatre, the right hand panel the arc pockets, that is, receptacles to which portable arc lamps, used for various scenic purposes, can be connected.

The stage lights consist of three colors, red, white and blue, and these are controlled separately. Referring to the left hand panel of the switchboard it may be seen that the handles of the first six switches in the upper row are white. These control the white lights in six different groups. The seventh switch is a master which controls all the white stage lights. In the second row on this panel the switch handles are painted blue showing that they control the blue lights, in sections, on the stage; there is also a master switch controlling the blue lights altogether. The lower row of switches controls the red lights, with a master switch as before.

The centre panel controls the lights of the main body of the theatre. These lights are sectionalized by numerous switches but there is also one master switch by which all the lights may be turned on or off at once. The arc light switchboard controls the arc lights in section, and is also equipped with one master as before.

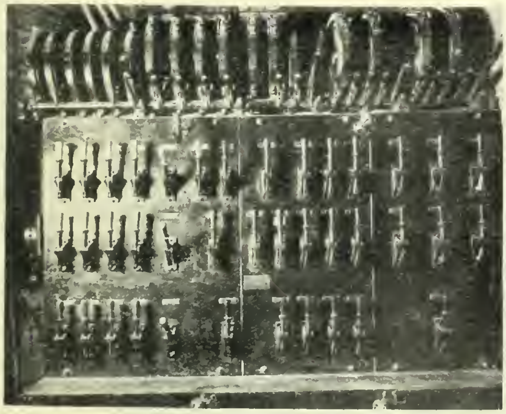


Fig. 1. Dimming and Control Switchboard.

Above the switchboard is shown the dimming machinery. The main body of the theatre can only be dimmed as a whole, and the control of these lights is shown by the first six sections (on the left) of the apparatus. Control is by one switch only and the resistances are so arranged that the variations in light intensities merge from one to the other without noticeable steps. The next seven sections control the white lights on the stage. These are sectionalized into six groups such as foot lights, borders, etc., each section controlled by its own dimming switch. All the white stage lights are also controlled by one master switch. This arrangement means that any one or more of the lights may be dimmed or all may be dimmed in unison. The third section of the dimmer controls the blue lights; there are four individual dimmers and one master dimmer. The fourth section represents the red dimmer; there are four individual dimmers and one master dimmer.

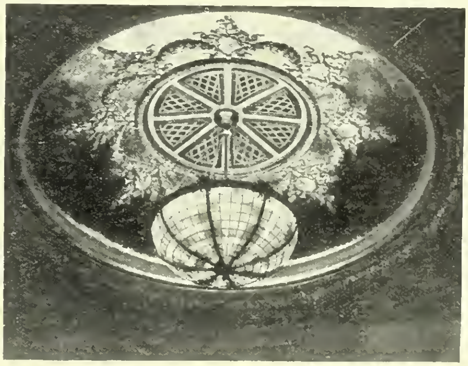


Fig. 2. Handsome semi-indirect unit.

The board is the latest type of dead face switchboard construction, all live parts being placed at the back. Below the board, not shown in the figure, there is a closed panel containing all the main fuses. This convenient location makes it possible for the operator of the switchboard to have control of the fuses without moving from his operating position.

At the back of the board is also a closed magazine panel made up in sections which correspond to the three sections of the main board, that is, one section controls the stage lights, one the house lights and one the arc pockets.

The main switchboard with all panels was supplied by the Metropolitan Electrical Manufacturing Company. A new feature of the panels is a slanting bottom which prevents the gathering of dust or anything else on the bottom of the panel board. We understand this design is being used throughout by this company. The dimming equipment is of the Cutler-Hammer type.

There is also an emergency lighting outfit entirely independent of the main switchboards and controlled from a small panel board in the box office. This supplies sufficient

light in case of accident which might disable the stage switchboards. All the wiring throughout is in conduit.

The second illustration represents a large handsome indirect lighting fixture hanging from the ceiling of the lower theatre. This unit is approximately one foot in diameter and carries 120-40 watt lamps controlled by six circuits separately fused.

The electrical installation, which is one of the most complete of its kind in Canada, was made by the L. K. Comstock Company under the direct charge of Mr. W. R. Wadsworth. This same company are at present installing the electrical equipment in Shea's new hippodrome, Terauley Street, Toronto. They have also just commenced work on the electrical installation of the Abitibi Pulp & Paper Company, Iroquois Falls, Ont.

Outdoor High-Tension Sub-Stations

Among the developments of recent years none has been watched by the high voltage engineers with greater interest than the work being done along the line of outdoor weatherproof equipment. The demands of the engineering world for efficiency, service, and economy have been realized by its development and standardization.

The installation pictured, which is on the lines of The Georgia Railway & Power Company, is a modern example of the application of standard outdoor apparatus installed to meet a special requirement, and is deserving of an especial mention. The outdoor sub-station is located about two miles from the centre of Atlanta, Ga., along the South Decateur trolley line at the junction of the line to the Soldiers Home. The sub-station is used for stepping up a voltage of 11,000 used in and around Atlanta to 22,000 volts, at which voltage the sub-station supplies power to the Stone Mountain-Covington, Monroe transmission line, a total of about forty miles. This sub-station of 3000 kv.a. capacity is supplied from the 11,000-volt line from Atlanta, which received current from various sources, including the new Tallulah Falls power station ninety miles away, the Bull Sluice station fifteen miles away, several other water power stations, and two steam stations in the City of Atlanta.

The station has been in operation about six months, during which time absolutely no trouble has been experienced, although the nearest operator or attendant is two miles from the station. Fig. 1 shows the high tension bus work carried over the transformers, the 11,000-volt bus on the left hand side, and the 22,000-volt on the right.

Each of the three transformers weighs about 12 tons, and to handle them without difficulty a special "I" beam construction was used between the car body, on which they were transported, and the concrete platform, on which the transformers are now installed. The concrete platform is on a level with a car floor and the transformers were skidded along the greased surface of the "I" beams to their proper places.

The two steel structures, each of which carries a three-pole Burke high voltage air-break switch, lightning arrester, choke coil, and fuse, are of one of the several standard models of outdoor sub-stations built by the Transmission Engineering Company of Pittsburgh, Pa. The transformers rest on steel rails, partly imbedded in the concrete platform and extending its entire length. This facilitates sliding them under the steel towers, which are provided with a U-bolt, from which tackle can be suspended to lift the coils out of the tanks in case repairs or inspection should prove necessary.

This sub-station, demonstrating the practicability of outdoor transformer installations, was manufactured by the Railway & Industrial Engineering Company.

Mr. George E. Etlinger, of the firm of Jno. Birch & Company, Limited, export merchants and engineers, of London, Eng., is at present on tour in the Dominion. A number of English manufacturers have placed their interests in Mr. Etlinger's hands and he is open to appoint agents for the well-known switch gear specialties manufactured by George Ellison, of Birmingham. Communications may be addressed care of the Canadian Express Company, Montreal.

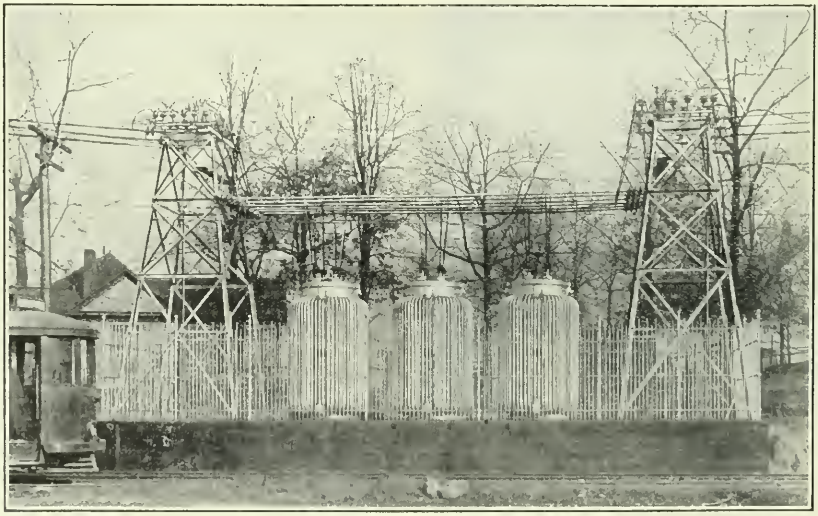


Fig. 1.—3,000 kv. a., outdoor, 11,000 22,000 volt, step-up transforming station.

New C. P. R. Montreal Station

The lighting installation recently completed in the new Windsor Station of the Canadian Pacific Railway Company at Montreal represents, at the same time, one of the most modern equipments both in control and in illuminating results that has been installed in Canada up to the present time. A brief description with interesting diagrams showing the layout of the wiring and lighting are given herewith and will prove of special value to the electrical contractor and illuminating engineer.

The new station measures, over all, including the main concourse, approximately 1100 ft. x 350 ft. The main panel which controls the whole of the lighting equipment is placed in the station master's office at one end of the concourse. From this point the different circuits pass out, three to the concourse and seven to the main section of the station where the trains are loaded. The station proper consists of eleven railway tracks, two between each row of supporting pillars. Each pair of tracks is separated by a passenger aisle.

The general distribution of the lights is shown in Fig. 1 The main panel board is seen at the lower end of the main concourse. The illumination scheme includes day lights, night lights, arc lights and bracket lights as shown in this figure. The day and night lights are 100-watt tungsten lamps enclosed in a steel enamelel (inside and out) Benjamin reflector fitted to a type "C" Crouse-Hinds condulet. The so-called arc lights consist each of a group of six 100-watt tungsten lamps.

Fig. 2 shows the general plan of the panel board for lighting the station. In the upper figure, which represents the train shed mains, current is supplied through two 500,-000 c.m. cables and one No. 0000 cable all enclosed in one three-inch conduit. The concourse mains consist of two 300,-

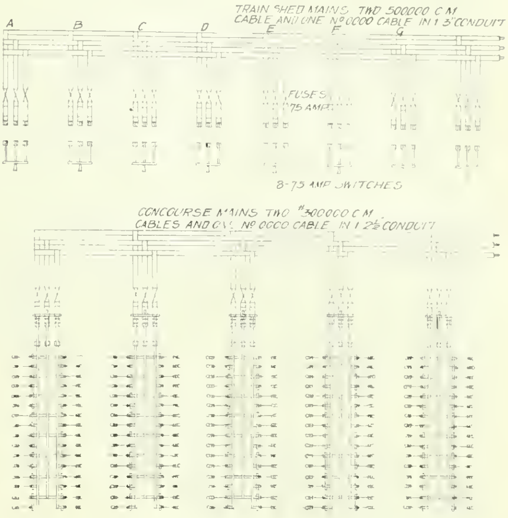


Fig. 2. Plan of control panel board.

000 c.m. cables and one No. 0000 cable contained in a two and one-half inch conduit.

Fig. 5 represents the wiring diagram of one of the three 3-wire panel boards used for fusing the individual lamp groups. These three boards are placed along the length of the train section of the station at approximately equal intervals. The location of one of them and the method of wiring to the returns is shown in Fig. 3, which is a section of the station similar to that shown in Fig. 1, only with the concourse omitted and showing a little more of the body of the station.

The wire is all run in conduit and all outlets, not ending in junction boxes, have condulets. The conduit is fastened to the steel work of the building by standard galvanized pipe clips.

The distance from the platform to the base of the lamp

Fig. 1. Section of Windsor station lighting system.

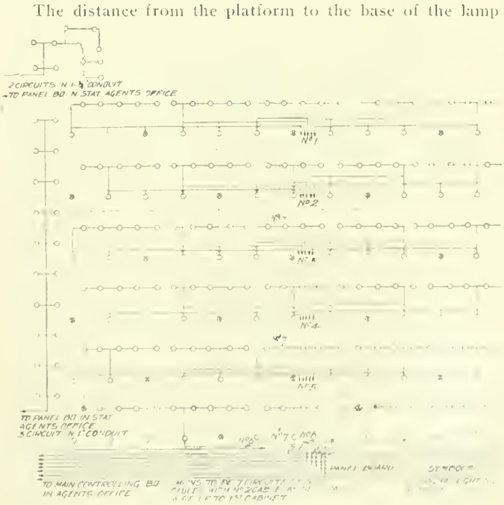


Fig. 3. Section of station showing one fuse panel.

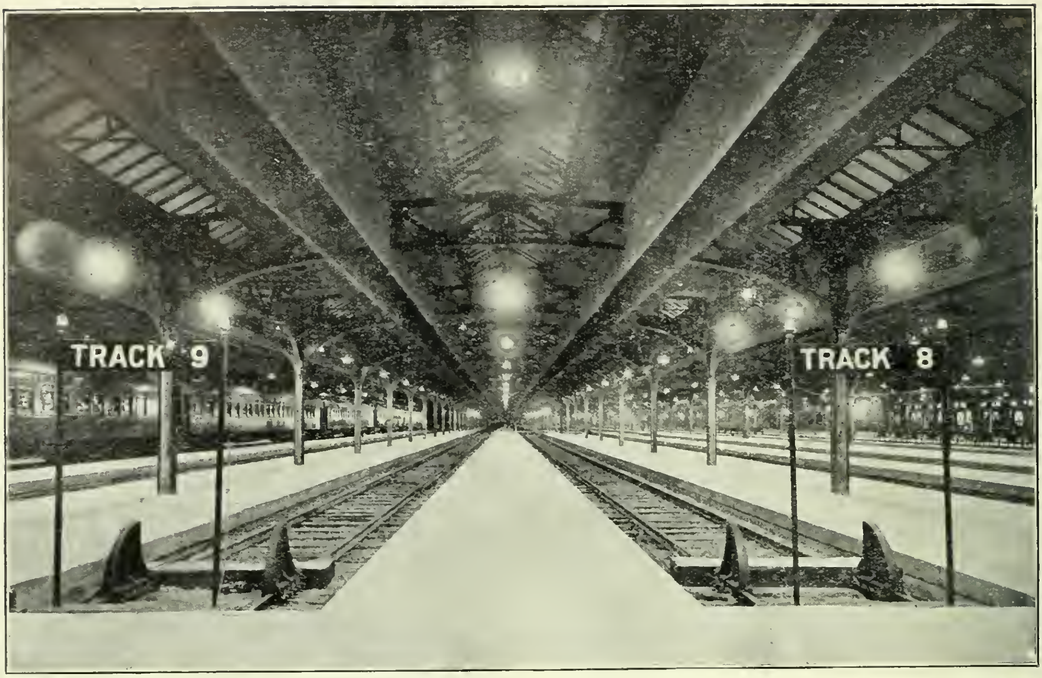


Fig. 4. General illumination view in the new C. P. R. Windsor Street station.

is fifteen feet and the lamps are spaced in alternate rows approximately twenty-eight and fourteen feet apart respectively, the rows being separated by a space of about twenty-two feet.

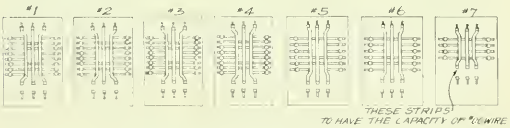


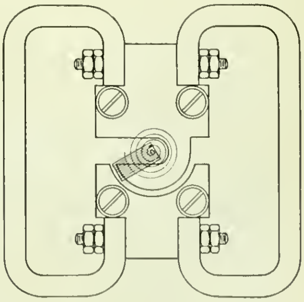
Fig. 5. One of three fuse panel boards.

Improved Laboratory Portable Meter

There has been a logical demand for a line of laboratory standard instruments, approaching in accuracy the meters of the precision type, suitable particularly for direct-current measurements, and therefore operating on the D'Arsonval principle. The ultimate limitation of such instruments, so far as permanence is concerned, is stability of magnetization of the permanent magnet. The old type of bi-polar or double-air-gap D'Arsonval construction, while sufficiently reliable for ordinary use, is considered somewhat questionable for use in instruments whose accuracy and permanence could be rated as high as that of precision instruments.

This limitation is overcome in the improved direct-current line of meters known as the "Type PL Laboratory Portable Meters" manufactured by the Westinghouse Electric & Manufacturing Company. They are made on the same design as the standard type PL portable meters which are adapted to general testing work, except that their extra long scale and strong magnets make them especially adapted for use as a semi-portable laboratory meter. They operate on the D'Arsonval principle, a moving coil and permanent magnet, which renders them free from all residual errors. The PL type meter differs, however, from other meters using the D'Arsonval principle in having a single air gap through which the moving coil, pivoted at one edge, swings. The single gap permits of maximum torque per unit weight for the following reasons:—

(1) The magnet will retain a higher permanent strength because the total air gap is relatively narrow and need never be disturbed. The complete movement can be taken out for inspection or repairs without removing any part of the magnetic circuit. Magnets in which the coil surrounds a cylindrical core forming part of the magnetic circuit, as in the usual double-gap movements, are subject to change in field strength if the coil is removed, because the cylindrical core has to be removed in order to remove the coil.



Plan of new portable meter.

(2) The strength of the magnet can be higher in the single-gap than in the double-gap movement for the mag-

nets of the latter can be only as strong as they would be when the core is out; otherwise they would lose a large part of their strength the first time the core and coil were removed.

(3) Since the coil when pivoted at one side counterbalances to some extent the weight of the pointer and thus reduces the counter-weight necessary when the coil is pivoted in the middle, as with the double-gap movement, the single-gap movement allows of a minimum total weight of movement.

(4) The strong magnets produce a high torque, which, with the light weight of the moving element, gives a high ratio of torque to weight, thus reducing friction errors to a minimum.

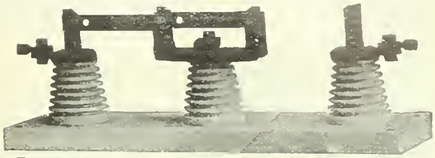
The accuracy of these meters is further assured by treating, magnetizing, and artifically ageing the magnets with their pole pieces complete according to the process originally developed by Madame Curie, the well known discoverer of radium, this process being recognized as incomparably superior to all other processes. To further guarantee against change in strength, the magnets after treating are stored for six months. Any magnets that show a decrease in strength after this time are rejected. The moving coil and pointer are then assembled in the magnetic structure and the manufacture is completed without disturbing the magnetic circuit, an arrangement impossible in the bi-polar D'Arsonval instruments. The light metal frame on which the moving coil is wound moves through the air-gap of the magnets and makes the reading inherently dead-beat. This important feature enables readings to be taken quickly and prevents violent fluctuations from injuring the pointer or the moving element. The scale, which is 11½ inches long, subtends an arc of 100 degrees, giving large open divisions which are of uniform length throughout. The scale has diagonal markings which facilitate accurate readings of fractions of divisions. A mirror extending the entire length of the scale enables the prevention of parallax in reading.

Electric Vacuum Cleaners

Among the portable type of electric vacuum cleaners the Eureka, manufactured by the Onward Manufacturing Company of Berlin, Ont., appears to be more than upholding its reputation as the most efficient and all-round reliable equipment that has yet been placed on the market. The 1914 model contains a number of valuable improvements. One of these consists in placing the wheels which uphold the nozzle just inside the nozzle instead of outside, making it possible to get much closer in to walls and corners. The handle is now allowed to move in a flexible way up and down without interfering with the angle at which the machine operates. The machine itself, in the new design, is held always in a fixed position on the floor by a third wheel placed under the motor. Other improvements consist in refinements of control and adjustment. In the illustration herewith the absence of the outside nozzle wheels can be noted as also the addition of the third wheel behind. It will also be seen that the adjustable handle enables the operator to work the machine with a maximum of ease. We understand that the Hydro-electric Power Commission of Ontario have adopted the Eureka as their standard and have recently placed orders for a considerable number.

Selector-Type Disconnecting Switches

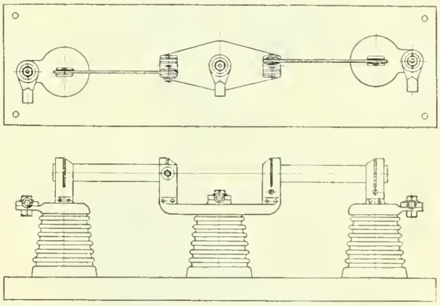
The selector-type of disconnecting switch is a transfer switch which does not require the circuit to be interrupted while making a change. It can also be used to connect two independent circuits in parallel. However, it is not designed for opening under load and therefore no attempt should be made to open it with current on the line. These switches are in effect two single-throw, single-pole disconnecting



Type O Selector type disconnecting switches with one side open.

switches with the hinge jaws connected together and mounted on the same insulator. The hinge jaw is also provided with dummy jaws to hold either blade of the switch in the open position. Except for these differences in the hinge jaws, the construction of these switches is similar to the standard disconnecting switches of the same ratings.

Two types of these switches are made. One type is intended for wall mounting, the live parts being mounted on porcelain insulators carried on a cast iron yoke or base. This forms a simple, but substantial, construction that is neat in appearance and moderate in price; all parts of this



Detail of type O disconnecting switch.

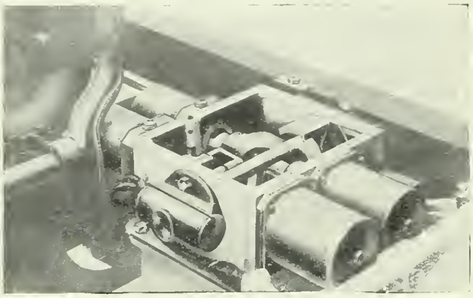
switch, but the porcelain insulators, are finished in black marine. The other type is designed for indoor mounting on marble bases or switchboard panels. It is made for either front or rear connection of for any combination of front and rear connection desired. The copper parts are dipped and lacquered. These selector-type disconnecting switches are extensions of the regular line of disconnecting switches manufactured by the Westinghouse Electric and Manufacturing Company.

Wheeler Condenser Equipment

Announcement is made elsewhere in this issue of the opening of a branch office in Montreal of the Wheeler Condenser & Engineering Company, Cartaret, N.J. This company was one of the first to concentrate its energies on the design and manufacture of steam condensing machinery and Wheeler condensers are now known the world over. With this equipment vacuums of from 28 to 29 inches are obtainable. Wheeler products include not only surface condensers but also high vacuum jet condensers, barometric condensers, centrifugal pumps, air pumps, feed water heaters, forced and natural draft cooling towers, etc. The Montreal office is in charge of Mr. Jos. McKay, Jr.

Electric Gear Shift for Gasoline Automobiles

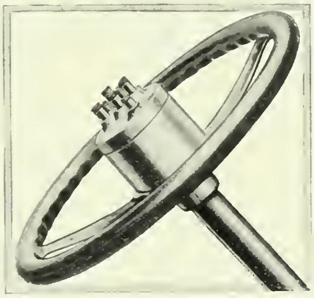
The accompanying illustrations make clear the principle involved in the electric shifting of automobile gears, a system now used by a number of the manufacturers of high grade cars. Instead of employing a hand operated lever to shift the gears, power for this work is supplied by a solenoid capable of exercising a 150-pound pull. In the Vulcan system four such solenoids, mounted under the car, control respectively the high, low and intermediate forward speeds and the



Vulcan Electric Gear Shift for Gasoline Automobile.

reverse speed. These solenoids are energized by battery current controlled from push buttons mounted on the hub of the steering wheel, the forward speed buttons being marked 1, 2 and 3 (for first, second and third speed) and the reverse speed button bearing the letter R. In addition there is a neutral button—N—which is used for stopping the car, and two auxiliary buttons (S and H) which enable the self starter and electric horn to be operated from the steering wheel.

When one of the speed changing buttons is depressed the circuit to the proper gear shifting solenoid is partly closed, but the actual closing of the circuit is not completed until the clutch pedal is thrown in, this carrying a small mas-



Showing push buttons mounted on steering wheel.

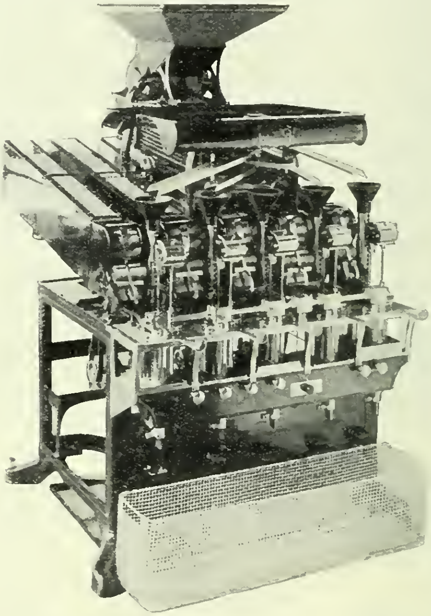
ter switch which completes the circuit to the battery. Very little current is used as none is consumed except at the instant the gear shifting solenoid is energized. Actual tests have shown that the time of engagement of the master switch, and therefore the time that current is flowing from the battery, is less than one-third of a second for each gear shift.

The Vulcan electric gear shift, formerly made by The Vulcan Motor Devices Company, Philadelphia, is now manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee.

Considerable support is being given to the proposals of the St. John Hydro-electric Company, who propose to develop power and transmit to this city.

Motor-Driven Coin Handling Machine

Dump a miscellaneous lot of coins into the hopper of the machine shown in the illustration, start the Westinghouse electric small motor that drives it, and the machine will sort out the coins into denominations, count them in dollars and cents, wrap them up in standard packages, or sack them as you prefer, separate the mutilated coins and throw them into a separate receptacle. Evidently this machine should become popular among companies that have to handle small coins in large quantities such as street railway companies, gas and electric companies, department stores, tax receiving offices,



water companies, banks, moving picture theatres, etc. It cuts down the time required to handle money and reduces the cost considerably. It also eliminates errors in counting and prevents pilfering. The machine is made by the Sattley Coin Handling Machine Company, Detroit, Mich.

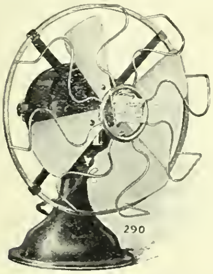
No Demerits

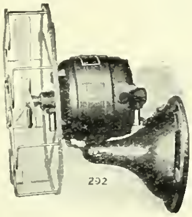
The Underwriters Laboratories Inc., Chicago, publish every three months a report which covers the products of the fourteen companies manufacturing metal conduit of different sorts in Canada and the United States. This corporation makes very careful daily tests of the products of each one of these companies and the daily records are carefully tabulated, arranged comparatively, and every three months distributed to the companies concerned. In the last report to hand, which covers the three months ending February 28, 1914, the Orpen Conduit Manufacturing Company of Toronto are to be congratulated on having no demerit marks on either their galvanized or enameled products. Indeed, for the last six months there have been no flaws whatever found in their enameled ware, so that they rank highest of all Canadian and United States factories. This is an exceedingly gratifying report for so young a company, which can only be interpreted as indicating that the methods of manufacture adopted by this company and the careful scrutiny exercised at every stage of the work, are of the best. The two principal products of this company to which they

have given the names "Xceladuct" and "Orpenite," representing respectively their galvanized and enameled products, are already well known throughout the Dominion.

A New Eight-Inch Desk Fan

The illustrations herewith show the new 8-inch direct current desk and bracket fan developed by the Robbins & Myers Company, Springfield, Ohio, for the season 1914. This fan is made for both 110 and 220 volts, direct current circuits. By means of a speed regulating coil and switch in the base, three speeds can be obtained, 1,700, 1,400 and 1,000 revolutions per minute. At these speeds the respective wattages are 25, 20 and 15. A hinge joint provides for trunnion adjustment, adapting the fan for either desk or bracket service. The blades are made of the best grade sheet brass, and are riveted to a punched sheet carrier which is formed to give a uniform pitch to all blades—the pitch being such as to give

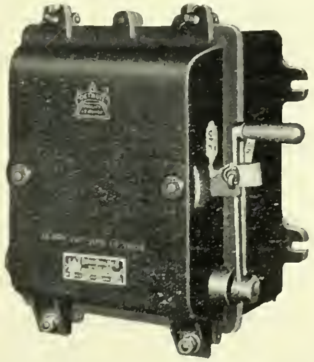




maximum air displacement with minimum power. A strong durable guard surrounds the blades; it is fastened to the body by four steel supports which are fastened rigidly by screws. This guard is amply strong to permit the fan to be carried about by it without injury. The frame and base of the motor are highly finished in baked black enamel with fine gilt stripes; the blades are brushed brass finish and lacquered. In all details the fan is built strongly; it runs quietly and meets the needs of the home or office where larger fans are not desired.

Awarded a Medal

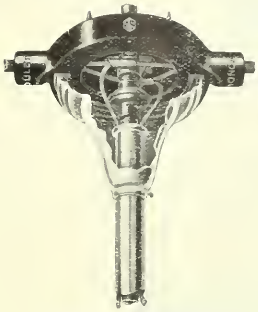
The Detroit Fuse & Manufacturing Company were recently awarded a silver medal, on their iron-clad fuse switches, by the First International Exposition of Safety and Sani-



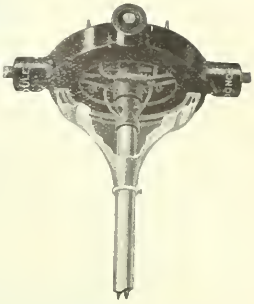
tation, held in New York. This was a recognition of the safety and accident prevention qualities of these switches. The cut herewith represents one of the types for which the medal was awarded.

New Condulets

The illustration herewith represents type PM series of condulets for electroliers and combination gas and electric fixtures. This series is designed for use in exposed conduit

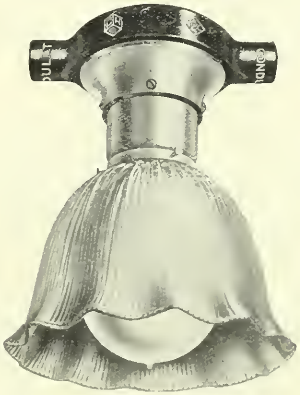


Arranged for combination gas and Electric Fixture.



Arranged for Electrolier – broken away view

systems and takes standard canopies and standard canopy installing rings from three to four inches in diameter. These condulets are so shallow that they are hardly noticeable when the canopies are fastened in place. A grounding clamp to ground the condulet on the gas pipe, above the insulating



Condulet with Abolite.

joint, is required with a combination gas and electric fixture. These condulets are being placed on the market by the Crouse-Hinds Company of Canada.

The Canadian Pacific Railway Company will extend their Alberta telephone system by some 410 miles of line this year. The work projected includes 27 miles out of Retlaw on the Suffield extension; 77 miles on the Lacombe branch; 25 miles out from Coronation; 150 miles from Bassano to Swift Current; 67 miles from Fort Steel to Golden. A quantity of this extension work is for connecting isolated systems already in operation.

The Great Western Railway Company of England have recently placed a contract with Herbert Morris, Limited, for the supply of all the chain-blocks which may be required on their system during the year 1914. This is the thirteenth successive year in which the Great Western Railway Company has decided to purchase Morris chain-blocks.

Indirect Unit for Summer

The cut herewith represents a type of indirect unit suggestive of summer weather. The bowl is contained in a wicker-work basket which gives a summer home or porch a

very attractive and artistic touch. This type of unit is being sold by the National X-Ray Reflector Company.

The Esterline Company, Indianapolis, manufacturers of curve drawing instruments, announce that they have added the General Supplies, Limited, 122, 11th Ave. West, Calgary, Alta., to their branch agencies.

New Books

Elementary Magnetism and Electricity—By Cyril M. Jansky, B.S., B.A., Associate Professor of Electrical Engineering in the University of Wisconsin; McGraw-Hill Book Company, New York, publishers. Price $1.50 net. This is in effect a text-book and the author has had in mind the needs of students who may have had some practical experience with electrical apparatus or machinery but whose knowledge of the principles of its operation and of mathematics is limited. It is intended for individual or home study although it may be used in class work to advantage. The apparatus required to perform the experiments is inexpensive, however, and it is believed that most of it can be made by the student himself. The book contains 206 pages, well illustrated and printed, and bound in the standard binding of this publishing house.

Electric Car Maintenance—By Walter Jackson, McGraw-Hill Book Company, Inc., 239 West 39th Street, New York, publishers. Price $3.00. This book is a selection of articles from the columns of the Electric Railway Journal with a few added diagrams to make the volume more illustrative. To those who are in charge of the maintenance of electric railway cars this book should be especially interesting and valuable. As a rule the methods described are such as require no costly apparatus and of a kind which may be applied to a great many situations.

New Companies

The J. Z. Lajoie Company, Limited, has been incorporated with head office Lajoie Falls, B.C., and capital $2,000,000. The company is given wide rights, including the generation and transmission of electric power.

The Erie & Ontario Railway Company are seeking a charter to operate by steam or electricity from Port Maitland to Port Colborne passing through the townships of Sherbrooke, Moullin, Wainfleet, Gainsborough and Grimsby. The company also ask authority to develop and distribute electrical power.

The Norfolk & Elgin Railway Company are applying to the Dominion government for incorporation.

La Rigaud Electric and Milling Company has been incorporated with a capital of $159,000 and head office Rigaud, Que.

Trade Publications

Hospital Signal Systems—Circular No. 15003 issued by the Holtzer-Cabot Electric Company, Brookline, Mass., describing the most modern hospital signal equipment manufactured by this company.

C. G. E. Publications—Illustrated booklet B3290 dealing with Edison mazda automobile lamps; B3289 on C-G-E electric fans for a.c. and d.c. circuits; booklet 881R4 containing a sketch of the development of the iron-clad oxide battery.

Wiring Devices—Section B of the electric supply catalogue issued by Factory Products, Limited, Toronto; illustrated profusely and describing, with prices, a number of the different lines of electric wiring supplies and devices carried by this company.

High Tension Switch Gear—The Delta-Star Electric Company, Chicago, are distributing a new Bulletin No. 3 devoted to high tension line and outdoor sub-station equipment. 105 illustrations are shown, many of which are working installations. This treatise will be of interest to those engaged in high tension transmission.

Portable Instruments.—Bulletin 104 issued by the Wagner Electric Manufacturing Company of St. Louis. This is a manual on electric testing and testing instruments illustrated throughout with splendid line drawings. It is in fact a brief text-book on electrical testing.

G. R. S. Publications—Improved lightning arresters Model 1-B, described and illustrated in bulletin 106A; Model 2-A Signals, described and illustrated in bulletin 115C and in booklet 2019; EZ motion plate rail clips and R.S.A. detector bars, described and illustrated in bulletin 130.

Progress Report.—On the reference by the United States and Canada in the levels of the Lake of the Woods and its tributary waters and their future regulation and control, including public hearings at International Falls and Warroad, Minn., and Kenora, Ont., dated January 16, 1914.

Charging Three Cells—A folder issued by the Westinghouse Electric & Manufacturing Company describing a good method of charging three cells, the number usually used for ignition and lighting in automobile work. The booklet describes the Westinghouse type G vibrating rectifier used for this purpose.

New Glassware.—A handsome catalogue has just been issued by the Jefferson Glass Company, Toronto, illustrating and describing in detail the newest ideas in these Canadian made products. Some of the reproductions are in color showing how the fixtures may be made to blend with the general decoration of a room. This catalogue is one of the most artistic publications of the year.

Burlington Steel Company, Limited

Owing to the similarity of the names of a number of companies operating in Hamilton and the confusion arising therefrom, the directors of the Canada Steel Company have decided to change the name of their company to the Burlington Steel Company, Limited. Business will be transacted in future under the new name.

Current News and Notes

Brantford, Ont.

The ratepayers of Brantford by a vote of 1317 to 83 have decided in favor of purchasing the local railway system and operating it is a municipal enterprise.

Calgary, Alta.

The firm of Kerry & Chace, consulting engineers, Toronto and Winnipeg, have received instructions from one of their clients to make a report on the possibilities of the Grand Rapids Falls on the Athabasca River. At this point there is said to be a possible head of 55 feet.

Edmonton, Alta.

The city council have called for tenders for cedar poles, tungsten lamp brackets and miscellaneous electrical material; also a quantity of wire and cable.

Gowganda, Ont.

Messrs. Chas. Barber & Sons, Meaford, Ont., have just completed the installation of an 800 h.p. hydro-electric power plant for the Miller Lake-O'Brien Mine, Gowganda, Ont.

Halifax, N.S.

A special turbine to supply light for the chocolate factory of Moirs, Limited, Halifax, is being supplied by Messrs. Chas. Barber & Sons, Meaford, Ont. This is a repeat order.

Hamilton, Ont.

The estimated cost of street lighting for 1914 is $88,125.

Hantsport, N.S.

A contract has been closed with the Canadian General Electric Company for the supply of electric equipment in connection with a small generating plant being installed as follows:—one 62½ kv.a., 1200 r.p.m., 2200 volt, belted generator; one 3 kw., 125 volt, belted exciter; one combination generator and exciter panel; lighting material, etc.

Kalso, B.C.

The electric plant of the Kootenay Electric Company will be taken over by the municipality as a result of the overwhelming vote of March 4. The purchase price is $27,500. This also includes certain undeveloped water power rights held by the company.

Khedive, Sask.

The Khedive Rural Telephone Company have called tenders for the installation of 35 miles of rural telephone line.

Kingston, Ont.

The Hydro-electric Power Commission of Ontario will be asked to give a report to the Civic Utilities Commission of Kingston on the power possibilities of a high falls on the Madawaska River, some ninety miles out from Kingston.

Kisbey, Sask.

Tenders are called by the Crocus Bell Rural Telephone Company for the equipment required in the construction of their system.

Montreal, Que.

As soon as the frost is out of the ground, the Montreal and Southern Counties Railway Company will commence the construction of an extension from St. Cesaire to Granby, a distance of 15 miles.

The Ferranti Electric Company have received an order from the Canada Cement Company for one 250 kw. La Cour motor-converter; also an order from Messrs. Armstrong, Whitworth & Company for two 350 kw. sets to be used in their new Canadian works in Montreal.

At the annual meeting of the Calgary Power Company, held in Montreal, one new director, Mr. C. C. Giles, was elected, and four former directors, Messrs. H. S. Holt, A. R. Doble, W. H. Hogg, and R. T. D. Aitken, retired. The board as elected is made up as follows:—R. B. Bennett, M.P., president; Sir W. M. Aitken, M.P., F. P. Jones, E. R. Wood, A. E. Cross, H. A. Lovett, C. C. Giles, with V. M. Drury, secretary.

After holding four meetings, a special civic committee of Montreal appointed to study the tramway report of Mr. G. R. MacLeod, railway engineer of the council, have adjourned "sine die." This report recommended the construction of subways and the improvement of the tramways service, and although the committee held four meetings practically no progress was made. In view of the aldermanic elections, it was felt that the question should be considered by a new committee, and that the interests involved were too important to be discussed by a dying committee.

The quantity of underground work installed by the Bell Telephone Company of Canada during the last 23 years, in five year periods is given by the following table:

Year	Miles Conduit	Miles Single Duct	Miles Cable	Miles Wire
1890	1.85	43.16	1.04	103.72
1895	12.10	143.64	16.35	2,211.54
1900	46.71	321.07	156.57	30,686.40
1905	99.62	572.56	264.34	94,131.80
1910	191.10	1,014.66	453.35	208,956.02
1913	258.00	1,577.00	710.28	335,735.00

At the annual meeting the board and officers were re-elected as follows:—C. F. Sise, president; Hon. Robert Mckay, vice-president; Theo. N. Vail, Robert Archer, Wm. R. Driver, Hugh Paton, Charles Cassils, H. B. Thayer, L. B. McFarlane, managing director; Z. A. Lash, K.C., F. N. Bethell, C. F. Sise, Jr., general manager.

Ottawa, Ont.

A delegation of over 2,000 persons—said to be the largest that ever appeared before the Dominion Government—met in Ottawa on March 26 to urge assistance for hydro-radials throughout Ontario. The necessity of improvement in the St. Lawrence waterways was also strongly urged.

Port McNicol, Ont.

The local branch of the Quebec Bank requires electric fixtures for the bank and attached residence.

Prince Albert, Sask.

The city council is considering the addition of a 750 kw. turbo-generator unit to their existing steam plant.

Tenders are called by the Provincial Department of Telephones for the erection of a telephone exchange to be built at a cost of $50,000.

A proposition to take over the La Colle Falls hydro-electric scheme and complete it, has been presented to the city council by N. W. Morton who represents the Anglo-Dutch Financial Corporation of London. The corporation asks a 40-year franchise for power and street railway operations.

Regina, Sask.

The provincial government have called tenders for the construction of a number of long distance telephone lines.

The operation returns of the city of Regina municipal street railway system for the week ending March 7 are as

follows, revenue $4112.15; passengers carried 96,912. The corresponding figures for the week ending March 14 are $5,093.75 and 119,810.

Rimouski, Que.

A turbine to light the mill of Price Bros. and Company is being supplied by Messrs. Chas. Barber & Sons, Meaford, Ont.

Saskatoon, Sask.

Contracts for electrical equipment have been awarded as follows:—pole type transformers, fuse wire, etc., Canadian General Electric Company; wire, cable and poles, Western Electric Company; meters, Ferranti, Limited.

Sherbrooke, Que.

The Sherbrooke Railway, Light and Power Company have closed a contract for the supply of 3000 h.p. to the Canada Brake-Shoe Company, Drummondville.

St. Catharines, Ont.

On March 20th delegates from different points in the Niagara Peninsula met in St. Catharines and formed a hydro-radial union for that district. Various resolutions were unanimously adopted dealing with the improvement of the waterways route of the St. Lawrence and the early construction of hydro-radials throughout western Ontario.

St. John, N.B.

The St. John Railway Company have placed an order with the Tillsonburg Electric Car Company, Limited, of Tillsonburg, Ont., for twelve cars, 20 ft. body, Brill 21E trucks. These cars will be turtle-back roof, interior cherry finish with vestibules arranged for p.a.y.e.

St. Lambert, P.Q.

The town of St. Lambert, P.Q., propose to improve their lighting arrangements, the plans including the erection of 43 5-light standards, and the construction of 7050 feet of single conduit.

St. Thomas, Ont.

An offer has been made to the city council by a private citizen to take over and operate the municipal street railway system for a period of five years. The offer is said to be favored by a number of the aldermen as, under the present system, there is an annual deficit.

Streetsville, Ont.

A by-law will be submitted on March 31 authorizing the council to raise $6,000 for hydro-electric extensions, power to be supplied by the Ontario Hydro-electric Power Commission.

Toronto, Ont.

In the local house Mr. Thos. Marshall, M.L.A., has introduced the following resolution. As Mr. Marshall is a liberal in politics it is evident that the hydro railway question is receiving the hearty support of both parties.

"That in the opinion of this House cheap and convenient electric railway transportation facilities are one of the most urgent needs in many rural sections, and the towns of the Province, and this House is gratified to see the general movement among the municipalities of the Province to secure improved electric railway transportation facilities through the Hydro-electric Power Commission.

"That this House views with satisfaction the prompt manner in which this question has been taken up by the chairman of the Hydro-electric Power Commission, and would respectfully memoralize the Government of the Dominion of Canada to grant to Hydro-electric radial railways constructed by or for the benefit of the municipalities of the Province under the direction of the Hydro-electric Power Commission a subsidy in all respects equal to that granted to steam railways under the provisions of the Act governing the granting of subsidies to aid in the construction of railways."

A great improvement is noted in many of the more dangerous street crossings in Toronto as a result of special lights being placed over the centre of the intersection. Tungsten lamps aggregating from 500 to 1,000 candle power are being used in each case.

Senator Peckham has introduced a bill in the New York legislature creating a waterways commission which will investigate and make a report at the next session as to what legislation is feasible to best conserve the water powers of the State and provide for their utilization in the public interests.

In his more recent public utterances the Hon. Adam Beck has suggested government ownership of the many independent telephone companies throughout Ontario. It is pointed out that there is much unnecessary duplication both of management and equipment which can be avoided under government control.

Verdun, Que.

The Montreal Light, Heat and Power Company have closed a contract for supplying the city of Verdun with 500 h.p. of current.

Winnipeg, Man.

A contract has been awarded by the Board of Control to the Standard Underground Cable Company for a quantity of weatherproof copper wire.

Welland, Ont.

The Welland Electric Company have closed a contract with the Ontario Tire & Rubber Company for the supply of 100 h.p. of electric energy at $12 per h.p. year.

Woodbridge, Ont.

A by-law will be submitted on April 11 authorizing the council to raise $6,000 by debentures to install a distributing plant. Power will be obtained from the Weston station of the Hydro-electric Power Commission of Ontario.

Electrical News

Generation, Transmission and Application of Electricity

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Vol. 23 Toronto, April 15, 1914 No. 8

The Vindication of Ontario's Hydro-Electric System

It is neither the province nor the policy of the Electrical News to boost any system or any type of electrical management at the expense of the others. We aim always and only to state the facts insofar as our knowledge and judgment teaches us, having in mind the general advantage of the electrical industry in Canada in its many varied phases. In this issue we have taken occasion to describe the operations of Ontario's municipal system during some three and a half years of active work. Fortunately the facts in our possession enable us to write freely and in a congratulatory strain. The present issue, however, is not intended in any sense as a defence of the system as we believe that all doubts and attacks have been best answered by the results. The commercial results are better, much better, than were originally hoped for. The costs of installation have been kept well within the estimates. The scope of the Commission's work is getting broader, with increased usefulness, each year. It can also be said, we believe, that politics has been made to play a subsidiary part. Of course the hands of the government have been strengthened by the success of their hydro scheme but that could not well be otherwise. They would have been correspondingly weakened by its failure. So far as we can judge there is no sign of diminished enthusiasm among the municipalities who are being served or those who hope soon to be supplied with electrical energy. There is no apparent sign that, except in a few diminutive cases, any insurmountable difficulty is being experienced in financing the various parts of the system. In short, there is no sign of bankruptcy at any part of Ontario.

In saying so much we do not wish to be understood as seeing eye to eye with the Commission in all that might have been done or that might be done in the future. We have frequently expressed ourselves as unalterably in favor of giving a square deal alike to municipality and private company. We believe that every possible care should be taken to shut out even the most remote sign of political interference. In as much as the credit of the whole province is behind the scheme every citizen of the province should have the same just consideration. In the main we believe the course pursued by the Commission has been fair and judicious and this presumably will become easier as the success of the work becomes more and more assured. The golden rule is as applicable here however as to any other phase of our daily life and the Commission will add to its usefulness in proportion as it wins the co-operation of the naturally antagonistic section of Ontario to this municipal undertaking.

Toronto's Annual Report

The annual report of the Toronto Hydro-electric Department as just made public indicates that the progress of the system for the past year has been very satisfactory. The number of meters in use, which presumably represents the number of customers, increased during the year by 80 per cent. and the peak load increased by 31 per cent.

The total expenditure to date is represented by an amount of $4,698,234, a figure somewhat out of proportion to the original estimated cost of this system though it must of course be taken into consideration that additions and extensions in excess of the original plans are very considerable and that lines have been built both for power and lighting service which will in all probability meet the requirements of the city for some years to come.

The net surplus has not been deemed sufficient to justify the Commission in giving the citizens of Toronto any lower rate than they now enjoy. A study of the report would seem to indicate that the Commission are acting very wisely in this matter. The financial aspect has been considerably changed during the last twelve months by the unsatisfactory sale of a quantity of debentures which has placed the system under the necessity of making good some half million dollars for which they receive no value. It would have been possible to cover this amount by the issue of further debentures but the commissioners have deemed it the proper course to assume the obligation just the same as if they had actually received the cash, and debit the necessary carrying charges against earnings.

It is a question open to discussion possibly whether it might not have been right to charge this against the city as a whole. If the city council undertakes to finance hydro matters and then bungles them as in the recent instance it seems reasonable that they should take the responsibility. The Commission, we believe, should be given authority to handle these matters themselves.

Looking to the future, the report states that it has been determined to install an auxiliary steam plant at an approximate cost of $1,000,000. The carrying charges on this will have to be taken care of though there will be no appreciable increase in revenue as a result of this expenditure. It would certainly appear to be the wisest course, therefore, to make quite certain that the revenue of 1914 represents a sufficient increase over the past year to take care of these added charges, before any reduction is made in the rates.

The tone of the report would seem almost to be suggestive of the vindictive at times. It is not easily understood what can be gained by giving further prominence to certain domestic matters that have long since been relegated to ancient history. The alleged mismanagement is not, even in the report, held to be responsible for the financial condition

of the system. It is not easy to understand either why the Commission assume no responsibility for the mismanagement of a business with the innermost workings of which they are supposed to be intimately in touch though in almost the same sentence they tacitly take credit to themselves in speaking of their new appointment and the efficiency of his work to date. Either their expressions of approval are to be taken with the proverbial grain or the public is to understand that they are now better seized of the managerial situation. Knowing the local conditions as well as we do we have no doubt that the Commission's expressions of confidence in the present manager are amply justified but the report is printed presumably for wide distribution and inference might be drawn.

Evidently the Commission is cramped for want of working capital. This is poor business, and the council should either see that the necessary funds are forthcoming or invest the Commission with power to provide their own capital. The latter we believe to be the better way.

Safety First

The Montreal Tramways Company have organized a very comprehensive Safety First movement, which is designed to influence every man, woman and child in the city. The prevention of accidents has, in one sense, an economical end in view as far as the company are concerned, but the thoroughness with which the plan has been laid out is evidence that the directors are also anxious that the public should be guarded from accidents of all classes. Mr. G. A. Gaboury, the superintendent of the company, who is primarily responsible for the movement, explains that no question of cost will be allowed to stand in the way of a complete educational scheme, and that it is intended to persistently instil into the public mind the idea of Safety First, so that an attitude of caution will become second nature to the people.

The first step in this campaign is the sending out of personal letters; then arrangements will be made to show moving pictures bearing on the prevention of accidents, these being exhibited to tramways employees in the club quarters and to the public in the ordinary theatres. Special exhibitions are to be arranged for children, who will be admitted free on passes supplied to the schools by the company. The children will be presented with little ticket purses and other novelties bearing the words "Safety First"; also blotters, rulers, scribblers, etc., with illustrations of how accidents are caused by carelessness.

The company will ask the co-operation of owners of every class of vehicle in showing signs; pictorial posters are to be displayed on the hoardings; large calendars, with illustrations of how accidents can be avoided, will be distributed to the schools, colleges, garages, stables, and offices; and letters are to be written to the thousands of auto, cab, express and wagon owners and drivers, emphasizing the importance of this educational campaign. Each letter will contain, besides, a personal letter to the recipient, circular pamphlets setting forth the dangers that attend traffic on the streets of the city where street cars operate, the dangers of greasy or wet rails, the possibility of brakes refusing to work or a car getting beyond control, and a hundred and one other eventualities that might occur to cause an accident, all of which may be avoided by waiting till the car has stopped before crossing the street either in front or behind it.

Besides this, "Safety First" signs will be placed on every street car, every trolley sign pole, every article of the company's property; and every transfer, letterhead, notices and stationery in general used by the company will bear the words prominently displayed.

Weekly meetings for employees of the company will be held, at which Mr. Gaboury will give short lectures on how to prevent accidents; instruction, drill and competitions for the men in accident preventive measures will be instituted; branches of the St. John's Ambulance Society will be established, and each of the men provided with small badges bearing the words in English and French, "Safety First," and "Prenez Garde." Extracts of the letters to drivers and chauffers will be sent to the street car men, in addition to the special instruction given them, so they may know what all are asked to do, and the motormen and conductors are cautioned to be as considerate towards vehicular and pedestrian traffic as they expect the latter to be towards themselves.

This plan is to be systematically developed and carried out, so as to thoroughly impress the public mind, and to prevent accidents which are a loss to all concerned.

Engineering Personals

The firm of Kerry & Chace, Limited, have lately made arrangements whereby Messrs. Arthur L. Mudge and A. Leo. Mieville have become associated with them as managers of the electrical and mechanical branches respectively.

Mr. Mudge for over four years was chief electrical engineer for the Toronto office of Messrs. Smith, Kerry & Chace during the period in which they had charge of the design and construction of hydro-electric plants and long distance transmissions for a number of companies, including,—the Electric Power Company, Limited, for whom six hydro-electric plants and one Diesel oil engine plant were constructed in Eastern Ontario; Calgary Power Company, Limited, Calgary, Alta., and Mines Power Limited, Cobalt, Ontario. For the past year Mr. Mudge has been chief engineer of the Midland Construction Company, which carried out most of the construction work for the Electric Power Company. With his present connection he is prepared to undertake consulting electrical engineering work including reports, valuations, designs, supervision of construction, and advice generally with reference to all matters in connection with hydro-electric developments, power transmission, local distribution systems, street lighting, power contracts, and industrial applications of electric power.

Mr. Mudge has taken an active interest in and has done faithful and energetic work for several of the technical societies having served for several years on the executive of the Toronto Section of the American Institute of Electrical Engineers, of which he was Chairman for a year. He is first vice-president of the Canadian Electrical Association and is engaged actively at the present time in adding to and improving the library of the Toronto Branch of the Canadian Society of Civil Engineers.

Mr. Mieville was at one time designer of high speed machinery for Allens of Bedford, England, a firm for whom he until recently acted as engineer in Canada, putting in several steam and hydraulic installations throughout the country. Previous to this, Mr. Mieville had acted as assistant engineer in the construction of the City of Winnipeg hydro-electric development and as turbine designer with the I. P. Morris Company of Philadelphia.

Before leaving England Mr. Mieville had been, for several years, engaged upon paper mill engineering and latterly in marine work, being occupied for a long time in designing engines, turbines and general machinery for torpedo boats, destroyers and other craft for British and foreign admiralties. This long experience in steam and hydraulic work should prove invaluable to the firm of Kerry & Chace, Limited, in building up their mechanical branch. Mr. Mieville is in a position to solve power and pumping problems in the light of the best modern practice and will undertake consulting work in these branches of engineering.

Hydro-Electric Operations in the Province of Ontario

A detailed description of the Engineering extensions and commercial operations of the system of the Ontario Hydro-Electric Power Commission since its inception some three and a half years ago.

Of interest to Manufacturers, Dealers, Engineers, Contractors, Operators and to every citizen of Canada irrespective of his calling.

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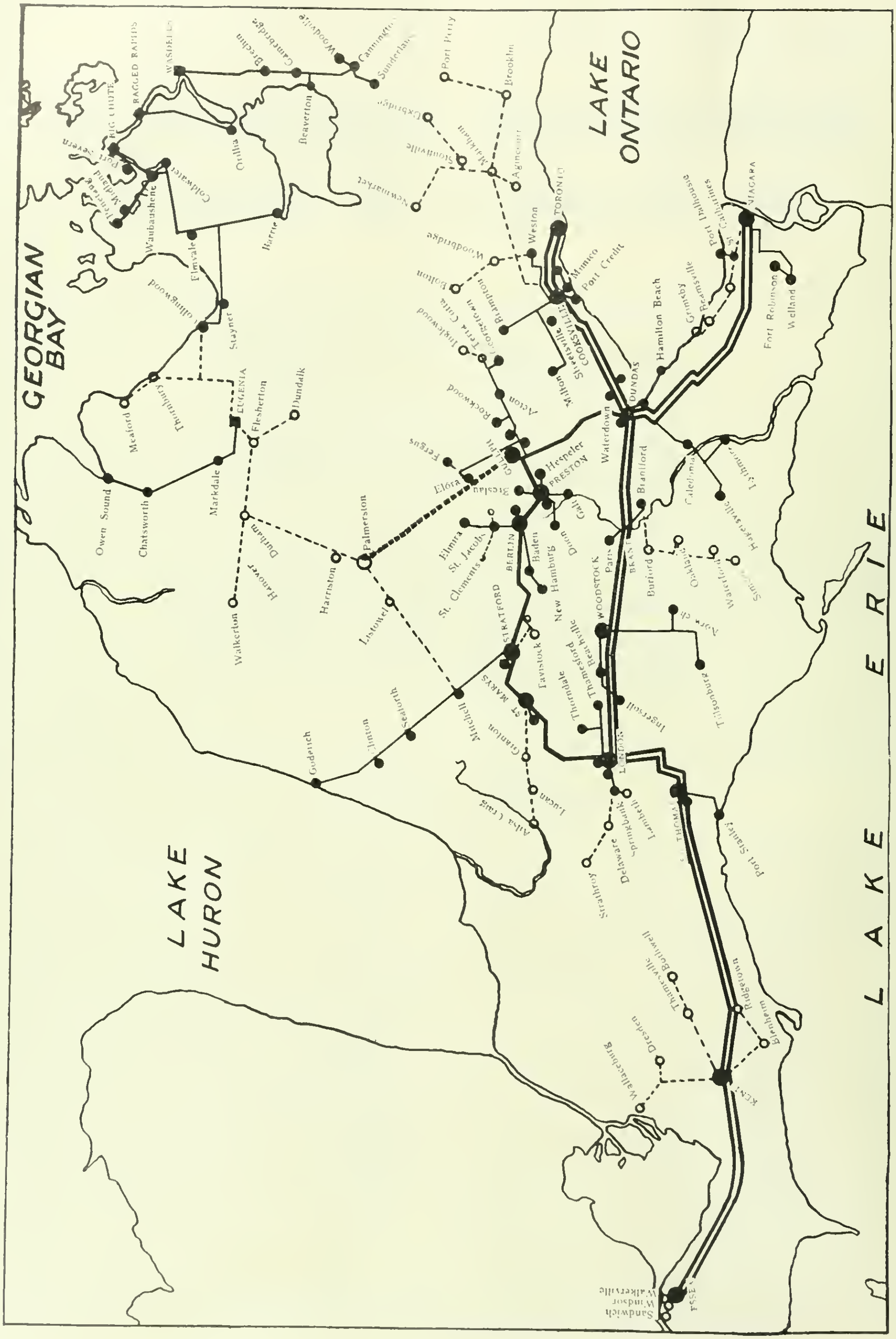


Fig. 1.—Map showing the extent of the area served by the distribution systems of the Ontario Power Commission from Niagara Falls, Severn River and Eugenia Falls.

Brief Retrospect to Previous Hydro Issue

The first stage in the scheme of hydro-electric development and distribution as being carried out by the Hydro-electric Power Commission of Ontario was described in the November, 1910, issue of the Electrical News. The work to that date had been almost entirely of an engineering character. The details had been worked out with minute and skilful consideration taking cognizance of all available experience and technical information known to the Commission's engineers. There was only lacking the proof that the great scheme was a commercially reasonable proposition.

The second stage of the Commission's work has been the turning of this system to practical and commercial account. It has been the work of the last three and a half years to prove to the world that the greatest undertaking of its kind is none the less a success because it is controlled by a people's government and operated for the direct benefit of the people who own it. From one end of Ontario to the other the judgments of the promoters of this great municipal hydro-electric movement have been confirmed. So that to-day Ontario boasts an enterprise which is universally recognized as commercially sound and as having benefitted very large areas and very large populations in different sections of the province without adding any load to the taxpayer. Nor does it show any signs of continuing anything but a source of education, pleasure, commercial development and financial advantage.

It is the history of this system from November, 1910, to April 15, 1914, that the present issue of the Electrical News will endeavor to describe in as much detail as the limited space at our disposal will allow.

Before proceeding with a description of the more recent work it will be well to review the situation briefly up to 1910 as described in our former hydro number. It will be recalled that a contract was closed with the Ontario Power Company for a supply of the necessary power up to 100,000 h.p. At date November, 1910, the power house of this company contained seven units with the eighth being installed. The generating voltage is 12,000, current being transmitted by underground cable to the step-up transforming station of the Commission located on the hill top, just at the rear of the generating plant. In this station the voltage is raised to 110,000 volts for transmission.

The transmission system up to the end of 1910 included a double circuit steel tower line from Niagara Falls to Dundas, from Dundas to Toronto, from Dundas to Guelph and west through Preston and Berlin to Stratford. The loop had also been completed by a double circuit tower line connecting Dundas with London directly through Woodstock, and continuing south to St. Thomas. Between Stratford and London a single circuit tower line only had been built. On these towers both circuits had been strung only from Niagara to Dundas and Dundas to Toronto. On the remainder of the towers only one circuit was yet installed.

Transforming stations, stepping down from 110,000 volts to either 13,200 or 6,600 had been built and equipped at each of the above-named points and distribution had been accomplished to some twenty-one municipalities. At the end of 1910 the total power load of all these municipalities had not reached 5,000 h.p., the system having been in operation only a few weeks before the close of that year.

Our former issue outlined in considerable detail the engineering features of the various sub-stations, to which was added information of a local nature describing the methods of installation of distribution systems both underground and overhead in a number of municipalities which were typical of the whole system. Wiring diagrams, showing the layout of the high and low tension equipment were given of all the high tension distributing stations. One of the most interesting reproductions was the first load curve of electric power supplied by the Hydro-electric Power Commission of Ontario which was made in Berlin on September 28, 1910.

Mr. F. A. Gaby, Chief Engineer of the Ontario Commission.

Abundant evidence of the growth of Ontario's municipal enterprise is found in the fact that the original twenty-one municipalities have grown to sixty-seven; the load of 5,000 h.p. has increased to approximately ten times that amount; nearly 600 miles of wooden pole lines have been built (this not including the work undertaken by the municipalities themselves); 103 miles more of 110,000 volt, steel tower transmission lines have been constructed; between 300 and 400 miles of 110,000 volt cable has been strung on the original towers. Welland is being reached by a 46,000 volt steel tower line. Operations have been extended to Port Arthur, Ottawa, Severn River and Morrisburg districts, in addition to much other work of which we shall speak in more detail in the pages that follow.

At the time the original equipment was installed at Niagara and in the various sub-stations throughout south-western Ontario it was

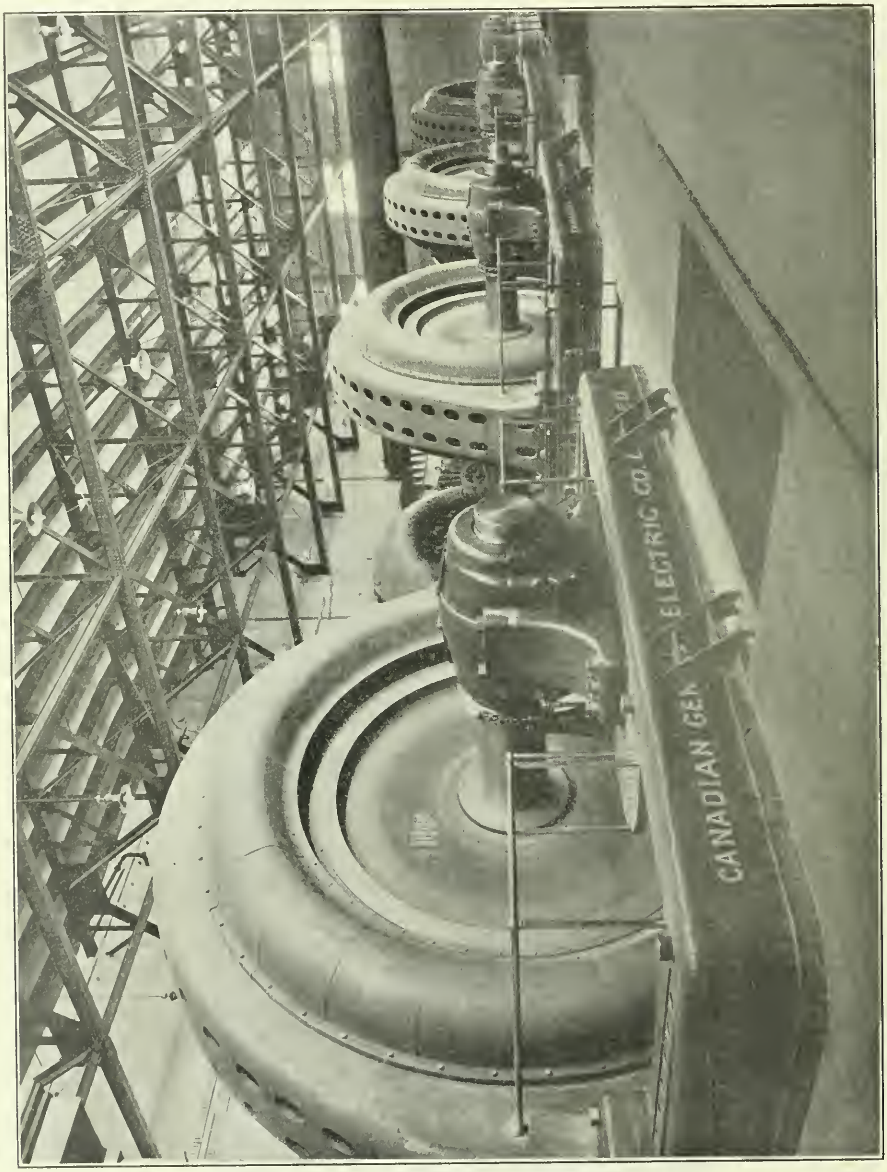


Fig. 2. Units 11, 12, 13, 14, Ontario Power Company, Niagara Falls. The last of these has just been installed. All were supplied by the Canadian General Electric Company. They are 8,776 kv.a. normal rating, 12,000 volts, 187½ r.p.m., 25 cycles.

believed that sufficient capacity had been installed to supply the demands for some years to come. The tremendous extensions and additions of the past three years and a half, however, have, as already indicated, been beyond the most sanguine expectations of the most enthusiastic supporter of the Commission's work and no better proof is required of the success, both engineering and commercial, of this enterprise than the big additions that have been necessary at nearly every point of the system.

In the generating station of the Ontario Power Company the eight generators have been increased to fourteen, largely as a result of the increased demands of the Ontario Commission.

The Niagara sub-station, which originally contained nine 3,000 kv.a. single-phase transformers now has a capacity of 73,000 kv.a. This is, of course, the result of increased requirements all over the system and it is gratifying to note that pressure of demand has necessitated increasing the capacity of a number of the original high tension transforming stations. For example, Toronto's original equipment of 7,500 kv.a. has been increased to 25,000; Berlin from 3,000 to 4,500 kv.a.; Preston from 3,000 to 4,500 kv.a., etc. In addition new high tension stations have been added to the Niagara system aggregating 25,000 kw., until the total transforming capacity in the various distribution stations on the Niagara system (controlled directly by the Commission) including the Niagara station itself is over 170,000 kv.a. Exclusive of the Niagara station the total is 96,500 kv.a.

In the operations which have been extended to the Severn River (Big Chute) district there is now an installed capacity of 2,800 kv.a. distributed to half a dozen towns. In the Port Arthur system there is an installed capacity of over 5,000 kv.a.; at Wasdell's Falls of approximately 1,000 kv.a.; at Prescott of approximately 450 kv.a. The Commission have also been instrumental in the organization of a municipal distribution system in Ottawa where power is purchased from a private generating company. The construction of hydro-electric radial lines at various points in Ontario has also received much consideration at the hands of the Commission and their engineers and it looks as if construction work would be commenced at an early date. In addition to all this a campaign of education has been carried on vigorously throughout the rural districts showing the value of electric power and its possibilities in farm work. Much success has been met in this respect and the future is promising.

The foregoing brief review will give the reader a general idea of the situation at the end of 1910 with the general progress made in the mean time.

As already stated the work may be considered as having divided itself into two stages, the first, the engineering stage; the second, the commercial stage. The general review which follows will be considered under these two headings with an added reference to the hydro-radial system, as at present outlined, and one or two other departments of the Commission's operations.

Throughout this work the personnel of the Ontario Commission has remained the same, namely, Hon. Adam Beck, chairman, W. K. McNaught and Lieut.-Col. J. S. Hendrie. The engineering staff has seen more changes, however, chief of which was the resignation of Mr. P. W. Sothman, and the appointment of his successor Mr. F. A. Gaby, who holds the office of chief engineer at the present time. Mr. Gaby has proved a thoroughly worthy successor to his former chief. He also understands local conditions thoroughly, being born and educated in the province.

Engineering Features and Additions

The constantly increasing demand for electric energy by the Hydro-electric Power Commission of Ontario has been largely responsible for the extensions to the generating station of the Ontario Power Company which now contains fourteen units with a total capacity of approximately 169,000 horse-power. The last seven units have been manufactured and installed by the Canadian General Electric Company and have a capacity of 12,500 kw. each. Generation, as in the original seven Westinghouse units, is at 12,000 volts. Fig. 2 shows the last four units installed, these being designated numbers 11, 12, 13 and 14. The first ten units, Fig. 7, are installed in a row and can be viewed from one point; the last four units, however, are placed at an angle and are partly hidden from view by the switchboard. The installation of the last of these units has just been completed.

Step-up Transforming Station

In the station on the hill current is stepped up from 12,000 volts to 110,000 volts. The original capacity in this station was 27,000 kv.a. but extensions at present under way and practically completed will bring the capacity up to 73,500 kv.a. The greater part of this capacity is to supply 110,000 volt lines running to Dundas, but it includes a capacity of 21,000 kv.a. in 46,000 volt transformers which are at present being installed to feed the power line being constructed to Welland, a town some twenty miles southwest of Niagara Falls. The plan of the Niagara Station as it will appear when complete has necessarily undergone considerable change as shown in Fig. 4. When this building is finished there will be space for eight banks of transformers, 12,000/110,000 volts, each bank to consist of three units of 3,500 kv.a. capacity each. At the present time five banks are installed with a total capacity of 52,500 kv.a. The station will also contain ultimately four banks of transformers 12,000/46,000 volts, each bank consisting of three units of 3,500 kv.a. capacity each. Two of these banks only are installed at the present time.

With the addition of extra transformers it has been necessary to add extra feeder cables. To feed the 110,000 volt transformers there have been installed, to the present time, four 12,000 volt underground feeder cables connecting the Ontario Power Company's generating station with the Commission's transforming station. All these feeders are carried in one conduit system.

Now, to supply the 46,000 volt power transformers which will serve Welland, 12,000 volt feeders placed in a separate conduit system are being installed. The specifications on this equipment called for six 300,000 c.m., three-conductor, paper insulated, lead covered cables.

The latest additions to 110,000 volt transformers were supplied by the Canadian Westinghouse Company. The general arrangement of the switching for the last bank is similar to that originally adopted. Both the 12,000 and 110,000 volt busses have been extended to connect up with the busses of the new equipment. The 12,000 volt feeder switches are of the reactance type and the 110,000 volt line oil circuit breakers operate on the same principle. Protection for the new 110,000 volt equipment is provided by electrolytic lightning arresters arranged with the arrester elements inside the station and the horn gaps on steel structures outside the building. The leads between the horn gaps and the arrester

elements enter the building through porcelain bushings similar to those used for line wires.

The 46,000 volt transformers were supplied by the Canadian General Electric Company. These transformers have 12,000 volt primaries and 26,400 volt secondaries and are connected in star on the secondary side so as to give a line voltage of approximately 46,000. The switching and protective equipment was supplied by the Canadian Westinghouse Company and is similar to that provided for the high tension transformers, that is, feeder switch, bus switch, transformer switch with auxiliary bus and six 46,000 volt oil circuit breakers, two for transformers and four for lines with electrolytic protection for each line.

The feeder switches on the 12,000 volt side and the 46,000 volt line breakers are of the reactance type and the arresters have grounded tanks, a feature which eliminates one of the dangers to which a station operator is often subjected unless the apparatus is guarded by a screen or rail.

The completed new building will be about two and one half times the length of the original station and the arrangement of the high tension transformers and the switching apparatus will be similar to the present arrangement; the 12,000 volt switching equipment for the high tension transformers as well as the intermediate tension transformers will be arranged similarly to the existing apparatus. When the station is fully equipped there will be a line of over forty circuit breakers extending over a length of 360 feet.

The intermediate (46,000 volt) tension transformers will be placed opposite the high tension transformers in the extension across the track run-way. The switching for these will be placed on the main floor behind the transformers, whereas the 46,000 volt busses and lightning arresters will occupy the gallery extending over the transformers and oil switches. The 46,000 volt lines will leave the building on the side opposite to the 110,000 volt lines and will be carried around to the south end of the building on steel structures.

In place of individual transformer rooms for the 12,000 volt feeders all cables will terminate in one long room running the entire length of the new building. A basement is provided in the entire extension thus giving more space for transformer and switch piping. It is the intention to place the auxiliaries such as water pumps, oil pumps and oil feeders in the basement beneath the 46,000 volt oil switches.

The switching equipment installed in connection with the fourth bank of 110,000 volt transformers is of more rugged construction than that originally furnished. The placing in operation of the new oil switches with resistances in circuit has improved the service materially. These resistance circuit breakers are placed outside the building and work in conjunction with breakers inside the building. The two circuits are placed in series and when an overload occurs of sufficient magnitude to open the circuit the switch outside the station opens automatically and in so doing places a resistance between the line and the inside breaker thereby reducing the load on the oil switch inside the building which automatically opens an instant after the opening of the outside breaker.

Niagara Falls to Dundas

Increased demands for power as well as a desire on the part of the Commission for a still greater factor of safety in furnishing the various municipalities with continuous power, has led the Commission to decide upon the building of a second double circuit line between Niagara Falls and Dundas which will follow a different route from the first double circuit tower line.

This matter was only recently decided upon by the Commission and no construction work has yet been done. When completed it will be very similar in design to the high tension lines at present under completion between St. Thomas and Windsor. When this line is complete there will be four different circuits connecting Niagara Falls with Dundas carried by two steel tower lines following different routes. The new line will be 4/0 copper equivalent steel cored aluminium cable.

Dundas

Dundas is the main high tension distributing centre of the Niagara system so that the apparatus installed here consists largely of switching equipment. In order to provide space for the switching and protective equipment required with the new 110,000 volt lines from Dundas to St. Thomas which have been recently installed and for the extra double circuit tower line to be built from Niagara Falls to Dundas it has been necessary to plan considerable extensions to the high tension section of this building. This extension is ninety feet long and the full width of the old building. A basement has also been provided under one-half of the extension.

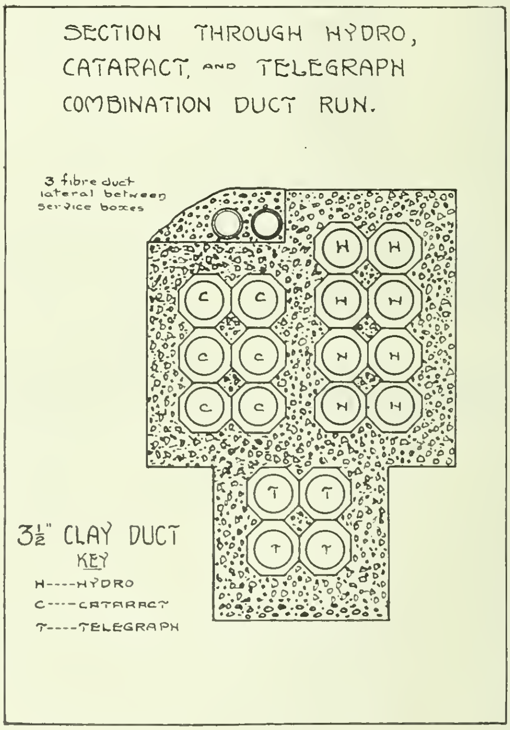


Fig. 3—Combination duct run, Hamilton.

For the new St. Thomas line there has been installed a 110,000 volt automatic circuit breaker, 110,000 volt disconnecting switches for connecting to each bus and a set of lightning arresters. The arrester tanks are placed inside the station and the horn gaps on special structures without the station. The arrester tanks are of the grounded type and an oil switch is installed for use in connecting the two 110,000 volt bus bars.

In addition, two sets of circuit breakers, disconnecting switches and lightning arresters will be installed in this station for the double circuit line being built from Niagara Falls.

The capacity of the low tension distributing end of this

station has also been increased. The original installation was four 750 kv.a. transformers stepping the current down to 13,200 volts for distribution locally and in Hamilton. This number was later increased to six but on account of further demands for power the smaller transformers have been removed and replaced by six 1,250 kv.a. units taken from the Toronto station. The 750 kv.a. sizes are, of course, being used elsewhere on the system where the capacity requirements are less than in Dundas.

At the present time there are eight 13,200 volt feeders leaving the Dundas station to supply Hamilton, Dundas, Waterdown, the Dominion Sewer Pipe Company, Caledonia, the Crown Gypsum Company, Hagersville, and Hamilton Asylum. Two of these lines have recently been put in for the city of Hamilton and the Canadian Westinghouse Company have supplied two of their type C. oil switches, two electrolytic lightning arresters, with a full complement of disconnecting switches, choke coils and other auxiliary apparatus. The original 13,200 volt bus bars have been extended to provide connection for the new feeders.

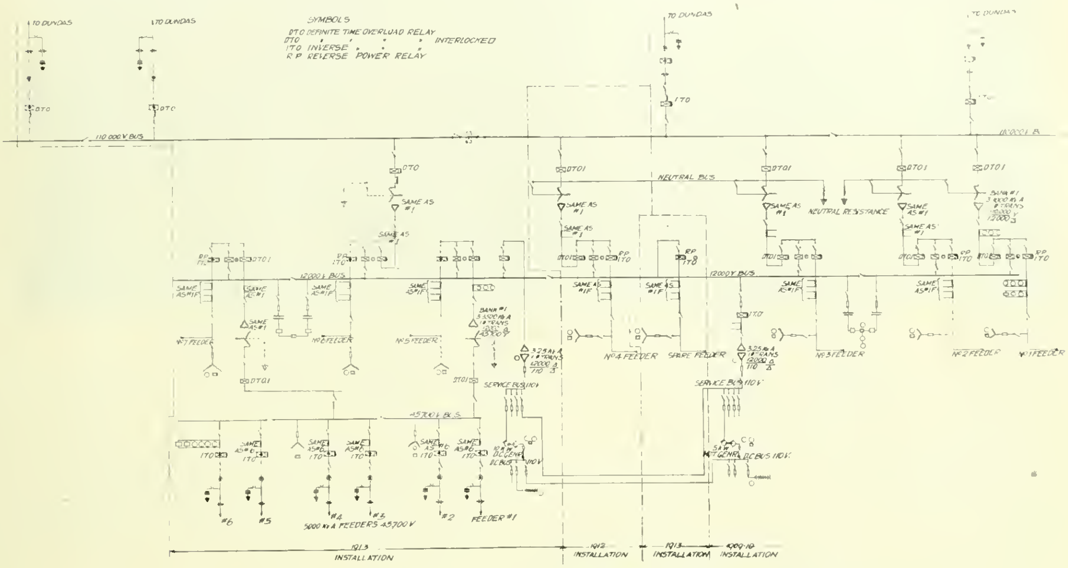


Fig. 4 Step-up transforming station at Niagara Falls.

Hamilton

The Hamilton system is not yet completed. There will eventually be three sub-stations and much of the central distribution is underground. Some interesting features of this plant are treated elsewhere in detail.

Caledonia

It is to be understood that the stations in the various municipalities are of two kinds called (a) distributing stations and (b) municipal stations. By a "distributing station" it is meant that the station is owned by the Hydro-electric Power Commission of Ontario as is also the equipment it contains. The obligation of the municipality starts with the 2200 volt line in this case. The expenditure in connection with these stations incurred by the Ontario Hydro-electric Commission for the municipality constitutes a loan which is to be taken care of eventually by the municipality and on which carrying charges are paid in the mean time.

A "municipal station" means that the municipality has built and equipped the station at its own expense. For the most part, the distributing stations are installed in smaller municipalities where the immediate expenditure is greater than the municipality can bear comfortably. This is one of the many co-operative features of the Ontario Hydro-electric municipal system which makes it possible for a small municipality to obtain power when otherwise the initial expenditure would make it impossible to do so.

Caledonia is a distributing station and there has been installed 13,200/2300 volt transformers of 450 kv.a. capacity. No unusual engineering features have been introduced into any of these stations, all having been installed according to standard practice.

Waterdown

This also is a distributing station containing 225 kw. capacity in 13,200/2300 volt transformers. Two 2300 volt lines run out from Waterdown, one to serve the local requirements and one to the Dominion Sewer Pipe Company.

Hagersville

Hagersville is a distributing station containing 225 kw. in capacity, of 13,200/2300 volt transformers.

The Crown Gypsum Company

The plant of the Crown Gypsum Company is located at Lythmore and the only property of the Commisson installed in this station is a recording watt meter for metering power which is supplied to the company at 13,200 volts. Transformers, switching equipment and protective equipment were all supplied for this station by the company.

Town of Dundas

The low tension equipment for power distribution locally in Dundas is situated in the high tension station. The total equipment consists of three 150 kv.a. units each stepping 13,200 volt current down to 2,300 and 575 volts.

Other High Tension Extensions to Original System

The original line from Dundas through Woodstock to London and south to St. Thomas was a single circuit No. 3/0

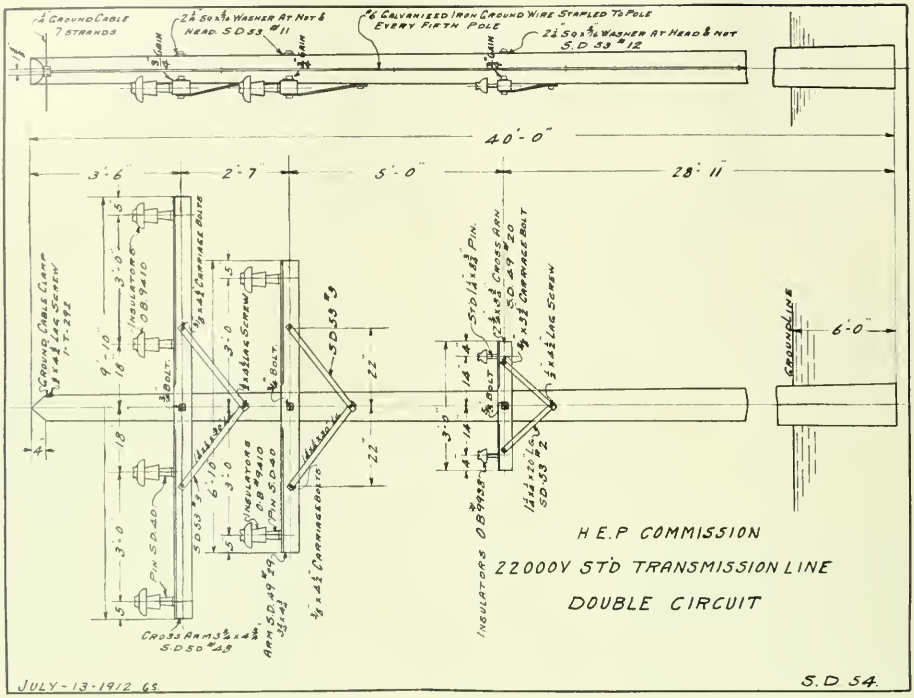


Fig 6. Standard 22,000 volt pole design.

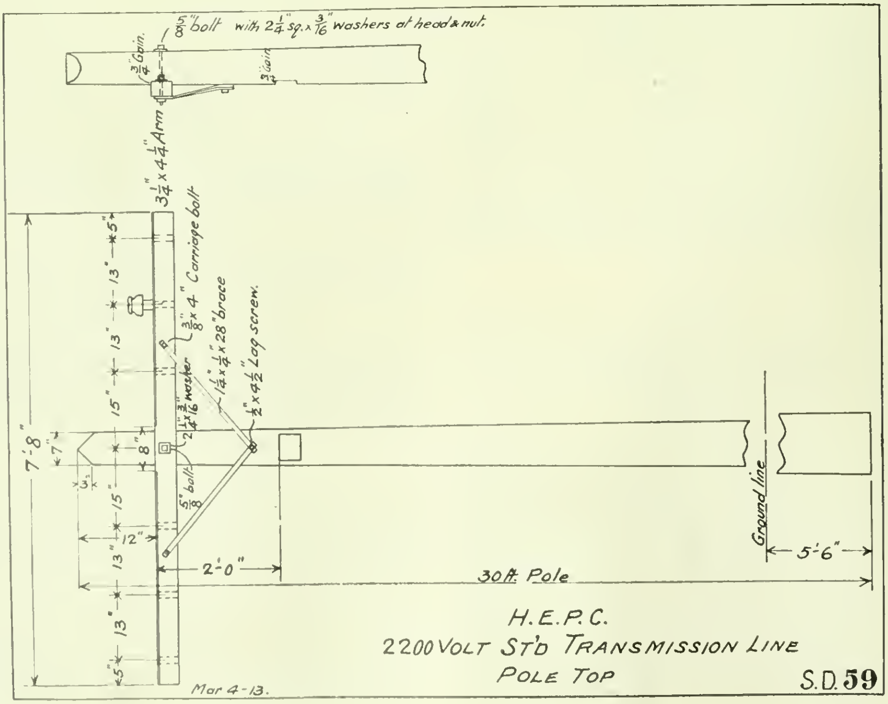


Fig. 5. Standard 2,200 volt pole design.

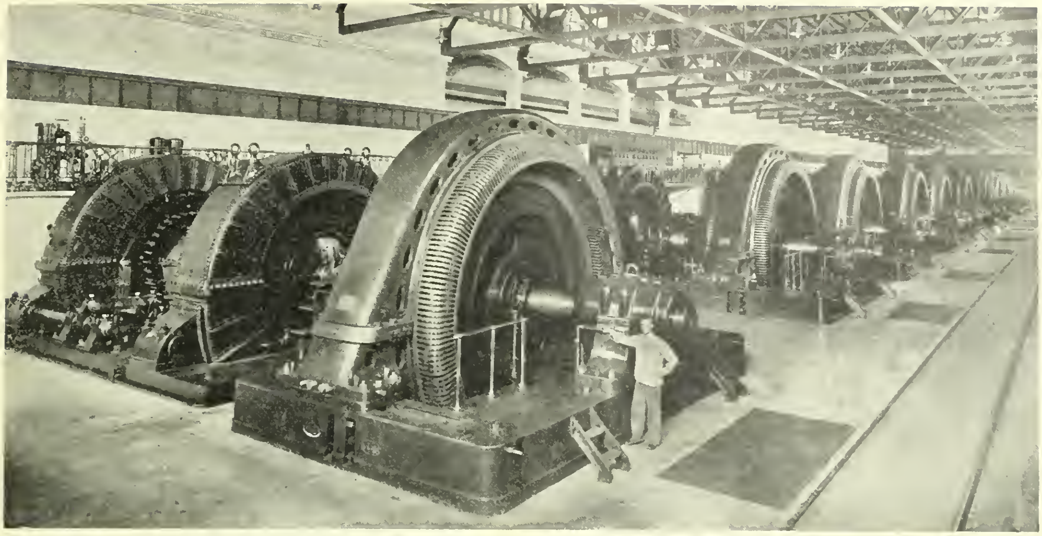


Fig. 7—Units 1 to 10 inclusive, Ontario Power Co. With units shown on page 56 total capacity is 169,000 h. p.

aluminium cable. Owing to the increased demand anticipated on the new section west of St. Thomas the 3/0 line has been replaced by two circuits of 4/0 copper equivalent steel reinforced aluminium cable between Dundas and London and by two circuits of 3/0 copper equivalent steel core aluminium cable between London and St. Thomas. The steel reinforced aluminium cable was only adopted after the most careful investigation. These extensions are not quite completed to date, but work is being rushed.

Toronto

A double circuit 110,000 volt line was originally installed between Dundas and Toronto and the carrying capacity of this line has been sufficient up to the present time. Toronto's original transforming equipment consisted of six 1,250 kv.a. capacity units. These have since been moved to Dundas station, as explained elsewhere, and seven 2,500 kv.a. transformers supplied by the Canadian General Electric Company have been installed. The Toronto station has been enlarged sufficiently to accommodate three additional banks of transformers as well as other equipment which the local Toronto Hydro-electric System use for supplying low voltage power in the vicinity of the transforming station. A further order for three additional 2,500 kv.a. transformers has also just been filled by the C. G. E. company so that the completed capacity of Toronto's station is now ten 2,500 kv.a. transformers representing three banks of three with one spare. In connection with the latter contract the same company also supplied a 110,000 volt oil switch, disconnecting switches, and the necessary extension to the existing bus line for connecting up the new equipment. The contract also includes the necessary 13,200 volt switching equipment for the new bank of transformers and an additional switchboard.

Cooksville

The equipment in this station has not been increased since it was first placed in operation early in 1912, and consists of four 1,250 kv.a. units stepping down from 110,000 to 13,200 volts. There were originally four 13,200 volt lines leaving this station but on account of the increased demands of this district four more feeders have been added. The equipment consists in each case of an automatic oil switch and electrolytic grounded tank type lightning arrester, disconnecting switches, choke coils, switchboard and panels and a full complement of indicating and recording meters. All this equipment was installed by the Canadian Westinghouse Company. The eight points served from Cooksville are the local service in Cooksville, Port Credit, Brampton, Weston, Milton, Streetsville and Mimico. From the distributing station at the latter point two 2,300 volt lines pass out, one for local service and one for the Mimico asylum.

The distribution stations supplied from this high tension sub-station are Cooksville village, Port Credit, Mimico, and Streetsville. Cooksville is supplied by 50 kva. in transformers; Port Credit by 225 kv.a. transformers; Mimico by 225 kv.a. transformers; Streetsville by 225 kv.a. In the latter case transmission is at 4,000 volts instead of at 2,300 as in the other three cases, the higher voltage being obtained by connecting the transformers in star on the secondary side.

Guelph

The capacity of the Guelph transforming station has not been materially changed. The original equipment consisted of four 750 kv.a. units and these have been replaced by the four units of the same rated capacity taken from Dundas Station, the advantage being in that the Dundas units were found to have a capacity considerably in excess of their normal rating. The four units originally placed in the Guelph station have been transferred, two to Preston and two to Berlin. No building extensions have therefore been incurred in Guelph.

Running out from the Guelph station there are now six sets of 13,200 volt lines serving respectively the city of Guelph, the Ontario Agricultural College, the Central Prison Farm, and the towns of Acton, Georgetown, and Rockwood.

Distribution stations have been established at Acton, Georgetown and Rockwood. At Acton there is a capacity of 225 kw. in 13,200/2,300 volt transformers. At Georgetown there is 225 kw. capacity in 13,200/4,000 Y connected transformers and in Rockwood there is 75 kw. capacity in 13,200/2,300 volt units. The Rockwood station is an outdoor type, the first of its kind to be used by the Commission. The

transformers are C. G. E. outdoor type mounted on a platform supported by wooden poles. They are connected to the line through horngap disconnecting switches and 13,200 volt fuses.

A municipal station has been established at the Central Prison Farm containing three 100 kv.a. units 13,200/2,300 volts.

A double circuit 13,200 volt line supplies the Ontario Agricultural College where a municipal station was installed in 1911.

Berlin

The Commission's station capacity has been increased to 4,500 kv.a. by the addition of two 750 units. Power is now distributed locally in Berlin by a 13,200 volt line, and four other 13,200 volt circuits serve Waterloo, New Hamburg, Baden and Elmira. From Baden two 2200 volt lines pass out, one for local service and a second to St. Agatha, a village in the vicinity.

Three distributing stations are served from Berlin, namely, New Hamburg, Baden and Elmira. New Hamburg was one of the earliest municipalities to take advantage of Niagara power. In each of these stations a capacity of 225 kv.a. has been installed, distribution being at 2200 volts except in the case of Elmira which is at 4,000 volts, through Y connected transformers.

Preston

The original equipment of four 750 kv.a. transformers has been increased by the addition of two more 750 kv.a. units. This brings the capacity up to 4500 kv.a. Power is now supplied locally in Preston by a 6,600 volt line which connects the high tension station with the town's sub-station. Four other 6,600 volt lines leave the Commission's station to supply Galt, Breslau, Hespeler and the Galt, Preston and Hespeler Railway Company.

The only distribution station served from Preston high tension station is Breslau where there is a total capacity of 225 kv.a. 6600/2300 volt transformers. The towns of Galt, Preston and Hespeler and the Galt, Preston & Hespeler Street Railway own their own transforming equipment.

Stratford

Owing to the addition of Goderich and Clinton to the Stratford demand the equipment in the high tension station has been more than doubled. The original capacity was 3,000 kv.a. made up of four 750 kv.a. units comprising three working units and one spare. These were used to serve the local requirements and two 13,200 volt lines were also constructed to serve Seaforth and Mitchell. During the past year an order was placed and the installation is just completed of four 1250 kv.a. units to step current down from 110,000 volts to 26,400 volts. From these transformers two 26,400 volt lines have been built one to Goderich and one to Clinton, the higher voltage being decided on as a result of the greater distance of these towns from the Stratford station. The four new units which include one spare, were supplied by the Canadian Westinghouse Company. They are of the water cooled type. The necessary 110,000 volt oil switches, disconnecting switches, and the necessary extensions of the high tension bus lines were supplied by the Canadian General Electric Company. The latter company also supplied the 26,400 volt transformer oil switches, the 26,400

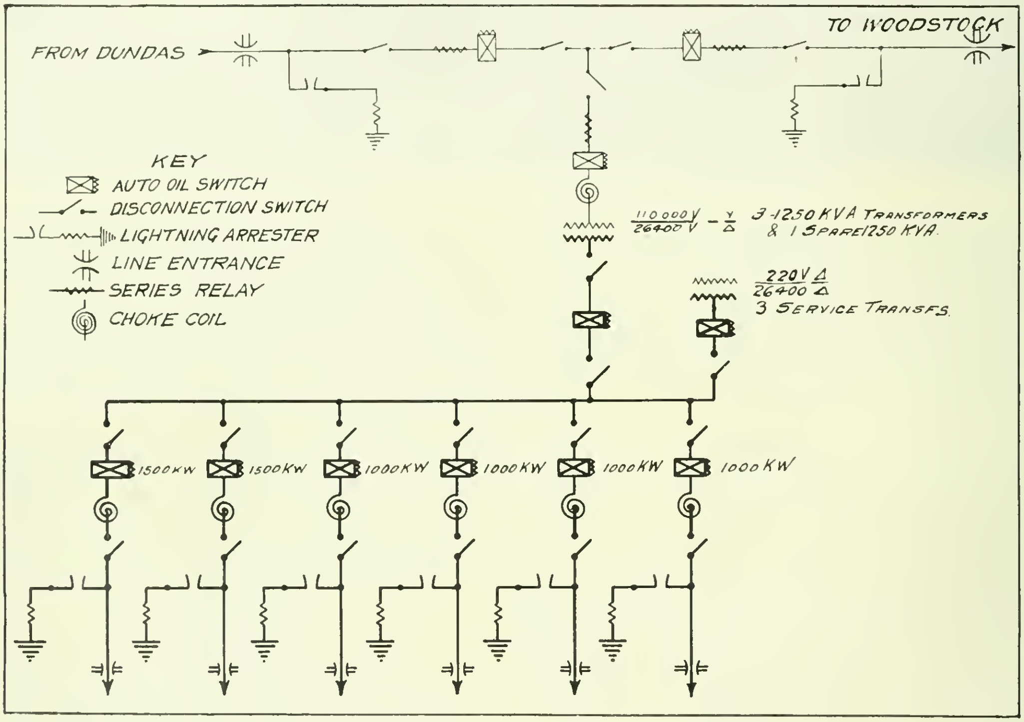


Fig 8 Wiring diagram of Brant Sub-station 5,000 kv.a. feeding Brantford and Paris.

volt bus bars, the four feeder switches, electrolytic lightning arresters and the necessary switchboard and auxiliary apparatus. Provision has been made in this station also whereby 13,200 volt power can be obtained from the new bank of 26,400 volt transformers in case of trouble in the originally installed units.

The installation of this additional equipment has necessitated the extension of the original sub-station building which work is practically completed.

Goderich

All the stations served by Stratford are municipally owned the most recent of which are Goderich and Clinton.

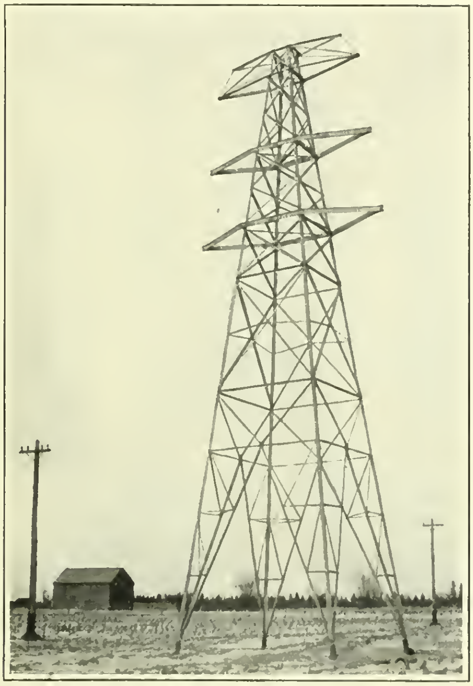


Fig. 9 Standard Line Tower Windsor Extension.

These two towns are supplied with power at 26,400 volts.

The Goderich station contains one bank of three 250 kv.a., 26,400/13,200 volt transformers and switching equipment for one incoming 26,400 volt line. The outgoing feeder lines include one 600 kv.a. power feeder, one 250 kv.a. three-phase lighting feeder and two series lighting feeders. There is one 3-phase regulator switch connected to the secondary taps of the transformers to regulate the voltage from 2200 volts to 2500 volts in 100 volt steps. Two 15 kw. single-phase, 25-cycle constant current transformers are installed in connection with the lighting system. The equipment was supplied by the Canadian General Electric Company.

The Goderich equipment is installed in the building which formerly was used as a municipal power generating station, the necessary alterations being made in accordance with the Ontario Commission's plans.

The Goderich metering equipment consists of a recording wattmeter and a recording power factor meter. These meters are connected on the secondary side of the transformers.

The town of Goderich operates its domestic water system electrically and there has been installed a 700-gallon per minute pump to operate against a 340-foot head and a 1450 gallon per minute pump to operate against a 480-foot head. These pumps are connected to synchronous motors which also have an influence in correcting the power factor.

Clinton

This station contains three 150 kv.a. 26,400/2,300-2,300/575 volt transformers of the self-cooled type with the necessary switching equipment for two incoming 26,400 volt lines. There is also one 300 kv.a. power feeder and one 150 kv.a. lighting feeder. The equipment was all supplied by the Canadian General Electric Company. Further equipment by the same company includes a recording wattmeter and a recording power factor meter connected to the secondary side of the transformers. There has also been installed a 150 kv.a., 750 r.p.m., 2300 volt, 25-cycle synchronous motor to be used for power-factor correction and by connection to a line shaft for any other purpose for which power is required.

The original service to Stratford city, Seaforth and Mitchell is at 13,200 volts.

St. Marys

No additions have been made to the original 3,000 kv.a. capacity. The town's principal customer is the St. Marys Portland Cement Company. A transforming station was supplied by the Cement Company and three 500 kv.a. water-cooled transformers were installed by the Commission to reduce the current from 13,200 to 575 volts for power purposes. It is intended in the near future to send out a supply of power from their station to Granton, Lucan and Ailsa Craig.

The St. Marys Portland Cement Company has an installed capacity of 1500 kv.a. belonging to the Commission. The current is stepped down here from 13,200 volts to 575 for motor operation. This is the only service leaving this station at present outside of the requirements of the town of St. Marys.

Fig. 10 Hamilton Pumping Station—C.G.E. Switch board, rear view.

Woodstock

No additions have been necessary to the 3,000 kv.a equipment in this station. Service was originally supplied to Ingersoll, Tillsonburg and Norwich as well as locally. A distribution station has been constructed at Beachville and 150

kv.a. capacity installed. During the past year a 2,200 volt rural line has been run out for some distance in West Oxford; this line is supplied from the sub-station belonging to the city of Woodstock.

Two distribution stations, Norwich and Beachville, are served from the Woodstock sub-station, each with a capacity of 150 kv.a. As noted elsewhere it has been adopted as a standard arrangement by the Commission that in the case of villages power should be supplied at 2,300 volts which necessitates no transformer station for these municipalities. All that is necessary is to make use of pole type transformers stepping down to the voltage required for lighting or power. This is the case in Norwich and Beachville.

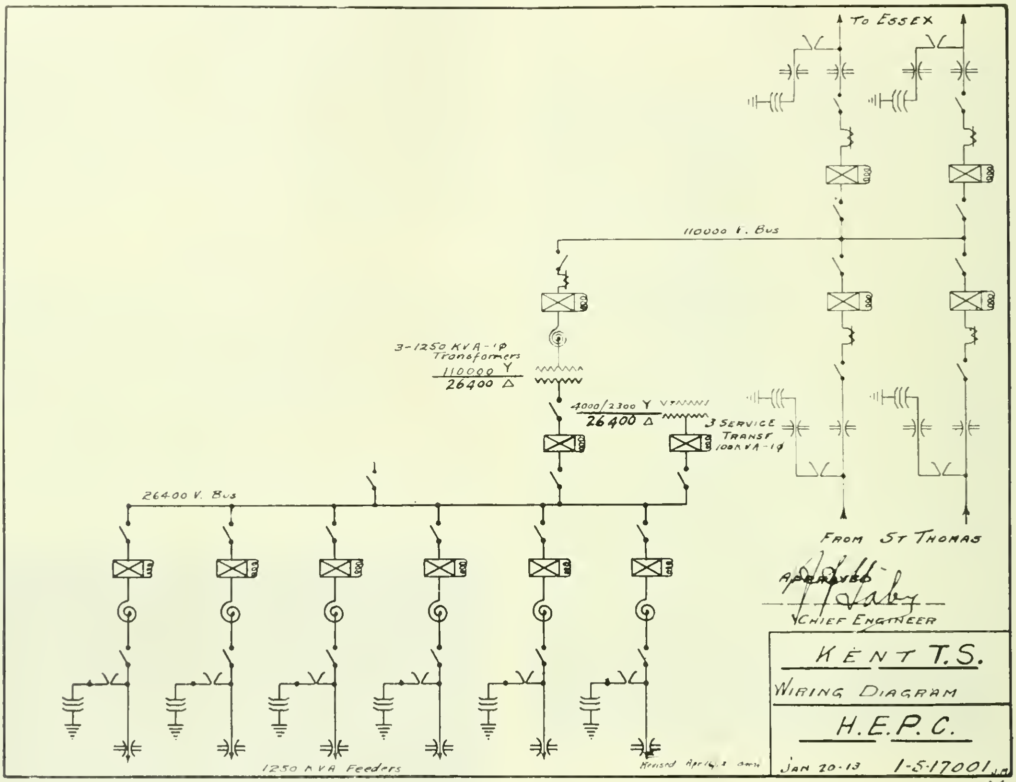


Fig. 11 Wiring diagram of Kent 110,000 volt sub-station, on the Windsor Extension. For key see Fig. 8.

London

The original transformer equipment installed in London consisted of four 1,250 kv.a. units, and no additions have been made since that time. 13,200 volt feeders pass out of this station for local service as well as one to the London Asylum and another to Dorchester. The equipment in Dorchester consists of three 25 kv.a. units which will be sufficient to supply the local requirements of Dorchester as well as Thamesford and Thorndale, distribution to these latter villages from the Dorchester station being made at 2,200 volts.

Extensions to the London transforming station were necessary on account of the new 110,000 volt line which has been strung from Dundas through London to St. Thomas. The new equipment installed consists of an automatic 110,000 volt oil circuit breaker for connecting London station to the new line from Woodstock and a similar breaker for connecting the new line to St. Thomas. These circuit breakers, as well as the necessary bus-bar equipment, switches and two 110,000 volt lightning arresters were installed by the Canadian Westinghouse Company.

The only distributing station served from London is Dorchester and at this point there is only 75 kv.a. capacity transmitted at 4,000 volts. From this distributing station power is also supplied at 4,000 volts to Thamesford and Thorndale where it is stepped down by pole type transformers for lighting purposes. The other 13,200 volt services from the London high tension station supply the local London sub-stations and the London asylum.

St. Thomas

With the extension of the 110,000 volt line west to Windsor, St. Thomas is no longer the terminal point on the line. To accommodate the switching equipment required on the new 110,000 volt circuit from London and for the double circuit line running west to Windsor it has been necessary to construct a thirty-two foot extension to the high tension portion of the building.

The equipment installed in connection with the new line consists of one automatic 110,000 volt oil circuit breaker for connecting St. Thomas station to the new line from London, two similiar breakers for connecting the new double circuit line running west to Windsor and one transformer bank automatic oil circuit breaker.

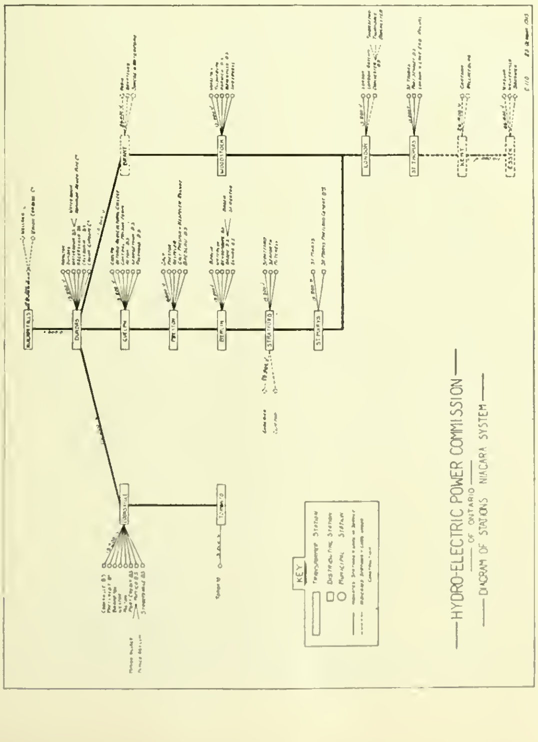


Fig. 12. Diagram of municipalitie served by Niagara system.

Fig. 13. Preston Power Station.

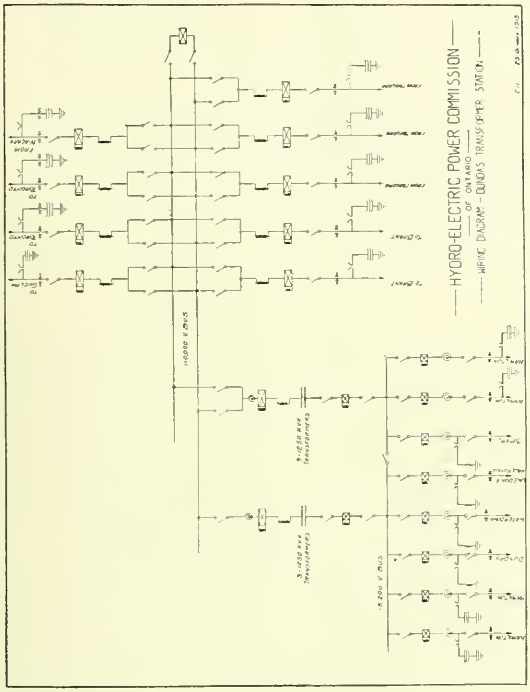


Fig. 14 - Wiring diagram of Dundas Inter-switching station.

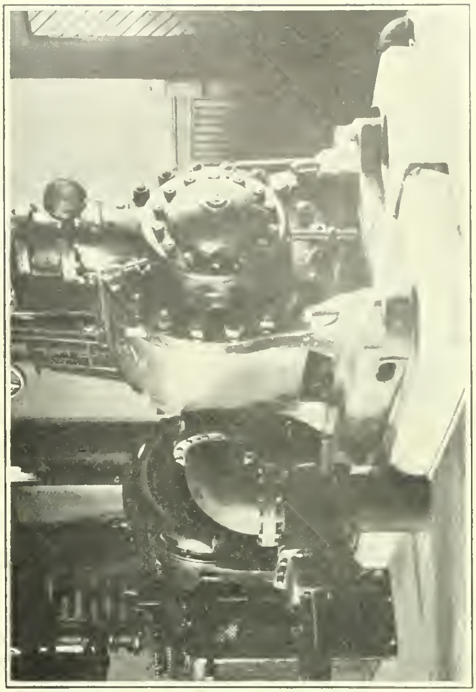


Fig. 15. Water works pumps in Galt.

The necessary bus bar extensions and disconnecting switches have also been installed. Three additional 110,000 volt lightning arresters have also been placed, one each protecting the two new lines west and one on the line from London. The arrester tanks are of the grounded type and are located inside the station with the horn gaps on steel structures outside. The Canadian Westinghouse Company supplied the equipment.

Additions to the low tension equipment in this station include a feeder panel and oil switch as well as the necessary equipment for supplying two outgoing feeders from one oil switch. Construction work has been completed in connection with the installation of a 13,000 volt oil switch with panels, meters and auxiliary equipment for supplying The London & Lake Erie Railway & Transportation Company.

The low tension lines passing out of the station are used for serving respectively the local requirements, Port Stanley and The London & Lake Erie Railway & Transportation Company.

In the distributing station at Port Stanley 150 kv.a. capacity has been installed.

Brant

The Brant Station, situated between the cities of Brantford and Paris, and used to serve both municipalities as well as any other corporations in the vicinity which may contract for a supply of power in the future, was only completed early in the present year. This station is on the direct line of the Dundas to Woodstock to London transmission. The 110,000 volt lines enter the station through oil circuit breakers on to the bus and pass out through similar breakers to the line. Both the incoming and outgoing lines are provided with electrolytic lightning arresters. The transformer equipment consists of four 1,250 kv.a. single-phase, oil insulated transformers three of which are connected in star on the high tension side and in delta on the low tension side. The fourth transformer is held as a spare.

The arrangement of the station is shown in Fig. 8. It will be seen that the lightning arrester tanks are placed inside the building. The transformers step down to 26,400 volts instead of 13,200, as in other stations—except recent extensions in Stratford. There will eventually be six 26,400 volt feeders each protected by an electrolytic lightning arrester of the grounded type. The Canadian Westinghouse Company supplied the complete equipment.

On account of the higher secondary voltage used in this station the arrangement is somewhat different. In the Brant station there are two galleries in the 26,400 volt section, the lower to accommodate the feeder and transformer switches, bus-bar and current transformers. The upper gallery contains the electrolytic lightning arresters. The space below the gallery is completely enclosed, and contains the switchboard.

A feature of this station is that is is heated throughout electrically by use of 10 kw. electric radiators in sufficient numbers to maintain the temperature at 65 deg. F. in the operating room, and at 50 deg. F. in the balance of the building, under the worst weather conditions likely to be encountered. During the peak load the radiators are cut off. A 45 ton crane with electric and hand hoist and a transformer truck are installed.

Brantford

The equipment in the city of Brantford municipal substation consists of two 750 kv.a. 26,400-13,200/4,000/2,300, 25-cycle, water-cooled, three-phase transformers. These were supplied by the Canadian Crocker Wheeler Company. Further equipment includes switching and protective apparatus for the transformers; two incoming 26,400 volt lines, three 4,000/2,300 volt, four-wire three-phase lighting feeders, three 4,000/2,300 volt four-wire, three-phase power feeders, and one 4,000/2,300 volt, four-wire, three-phase feeder to the constant current street lighting transformers. These were supplied and installed by the Canadian General Electric Company.

Paris

This station contains three 200 kv.a. 26,400-13,200/2200-575 volt, 25-cycle, oil insulated self-cooled C. G. E. transformers and three 15 kw. 6.6 ampere 25-cycle constant current transformers. The same company supplied switching equipment for the above and for the two 26,000 volt incoming lines, also one 600 kv.a., 2300 volt power feeder; three 150 2,300 volt, three-phase lighting feeders and three series street lighting feeders. This equipment is installed in the old power house in which the necessary changes have been made.

The Windsor Extension

The surveys for the route of the Windsor Transmission Line were commenced in January, 1913, although a considerable amount of preliminary investigation was done during the years 1911 and 1912. Early in January, 1913, an exhaustive study was begun of routes between St. Thomas and Windsor, taking into consideration relative costs, right of way, length of line, difficulties of construction of tower and wood pole lines, necessity for bridging and the general character of the country passed through. Several different routes were investigated and the following finally adopted.

Commencing at the St. Thomas sub-station, this line runs in a westerly direction a distance of 1.4 miles to the intersection of the Edgeware Road and crosses the Southwestern Traction and the Wabash Division of the Grand Trunk. It then deflects to the left and paralleling the Edgeware Road, it runs for a distance of 7 miles to a point immediately south of the Michigan Central Railway near the Village of Shedden. In this section it crosses Dodd's Creek and the main line of the Michigan Central Railway. At Shedden the line deflects to the left crossing the Pere Marquette Railway there and parallels this railway for a distance of 37.1 miles to a point just west of Ridgetown. In this section it passes through the villages of Shedden, Iona, Dutton, West Lorne, Rodney Muirkirk and Highgate, and after crossing the Pere Marquette Railway just east of Ridgetown, passes through the northern part of this town. At this point it deflects to the right and runs straight across country, a distance of 10.7 miles to a point in Lot 7, Concession 3, R.T. Township of Harwich. In this section the main line of the Michigan Central Railway is crossed. The line then deflects to the left and paralleling the road allowances, runs in a southwesterly direction through the City of Chatham, a distance of 3.5 miles, to a point in Lot 20, Concession 2, R.T. Township of Raleigh. At this point it deflects to the right and parallels the G. T. R. immediately to the south of it for a distance of 3.3 miles to the intersection of this railway with the Canadian Pacific Railway. It then deflects to the left and parallels the Canadian Pacific Railway immediately on the south side of it for a distance of 39.8 miles to Walkerville Junction. The total length of this line is 102.8 miles, being much the shortest line of all those investigated. For many reasons it was the most economical to build on account of the great length of line which parallels and is adjacent to railway lines, right of way would be much cheaper than any other line investigated. Also construction was carried out at a lesser cost on account of the railway facilities for distribution of material. From Chatham to Walkerville Jct. the amount of bridging necessary was slightly more than that of any other line on account of the fact that it is much closer to Lake St. Clair where the rivers and drains are much larger. This, however was not a serious matter and would count very little against the choice of a location.

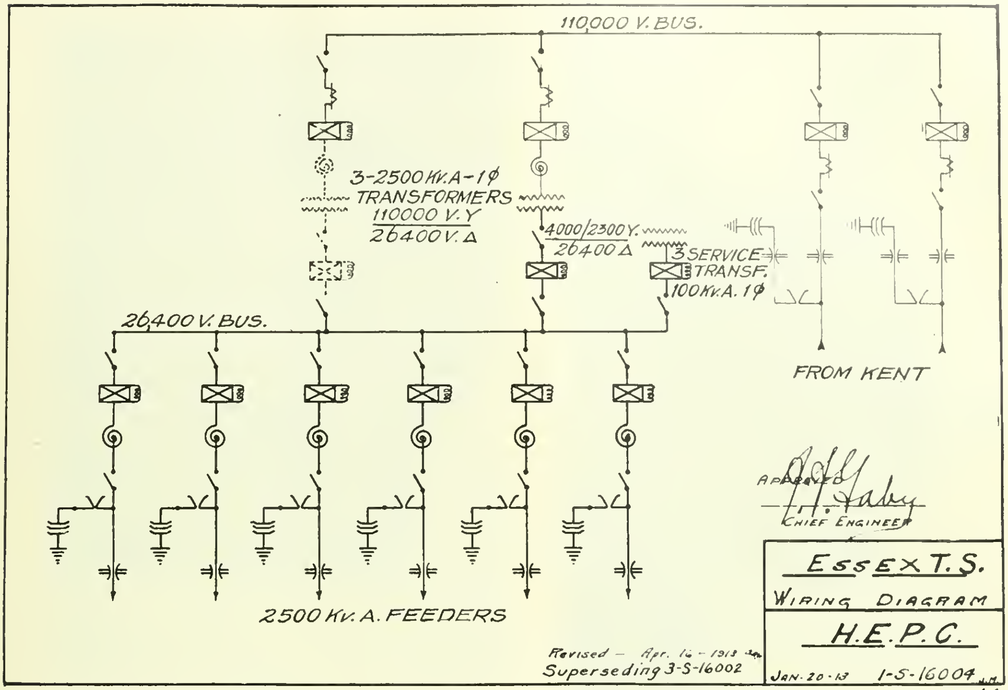


Fig. 16—Wiring Diagram of Essex Station—The Western Terminus of the high voltage line.

During the latter part of 1912 various types of transmission line construction work were considered, and it was decided to use tandem construction, where the three wires of each circuit would be in one plane approximately vertical, and removed about 7 feet from the face of the conductor support.

On account of market and other conditions, No. 3/0 B. & S. gauge copper cable was specified for conductors, and a standard span of 660 feet between conductor supports was adopted.

Early in 1913 instructions were issued by the Commission to undertake the work of construction of the Windsor transmission and telephone lines, following plans similar to the construction of the low tension lines, and an organization was formed to take care of this work. The gangs employed for transmission line work were as follows:—

Two gangs, each of about 25 men, excavating for tower footings.

Two gangs, each of about 20 men, setting tower footings.

One gang of about 10 men building culverts and bridges, and temporary fencing.

One gang of about 12 men clearing right-of-way.

Two gangs, each about 25 men, assembling towers.

Two gangs, each 7 men, erecting towers.

The unloading of tower steel was done by a gang of six men, and the steel was delivered to the tower locations by teams hired along the line.

Each one of the above gangs was in charge of a foreman, who received his instructions from the general foreman in his section.

The gangs employed for telephone line work were as follows:—

One gang of 15 men digging holes.

One gang of 10 men erecting poles.

One gang of 3 men unloading and framing poles.

One gang of 4 men assembling and erecting cross arms, setting anchors and attaching guys.

One gang of 8 men stringing wire.

Each of these gangs was in charge of a foreman, who received his instructions from the general foreman of the telephone line.

The work of excavating and setting tower footings was begun July 1st, 1913, and was carried forward at such a rate that on October 31st only 76 of the 860 footings remained to be set. The footing gangs met with a good deal of trouble from water in the case of tower footings from Chatham to Tilbury. These were the first set, and the ground was still full of water. Also in the neighborhood of Ridgetown, West Lorne, and Dutton, a good deal of quicksand was found, and shoring of the holes was necessary. In all cases, however, a good solid bottom was reached at the standard depth.

Culverts and bridges were commenced a week ahead of the tower footings and were kept well in advance of this work throughout.

Tower assembling was begun on October 7th and the first tower was erected on October 14th. Up to the end of the month 52 towers had been assembled and erected.

Work on the telephone line was begun early in August and the first pole erected on August 16th. The digging of holes and erecting of poles was carried forward rapidly, so that this part of the work was practically complete from Chatham to Windsor by October 31st. At date of writing the transmission line is practically completed.

Owing to the fact that this work was carried out by the Commission instead of by contract a considerable saving was effected in the total cost as compared with previous estimates. The right of way of this tower line is sixty-six feet wide and was purchased outright by the Commission. The

Fig. 18—Typical Distributing Station, 13,200/2,300 volts—Mimico.

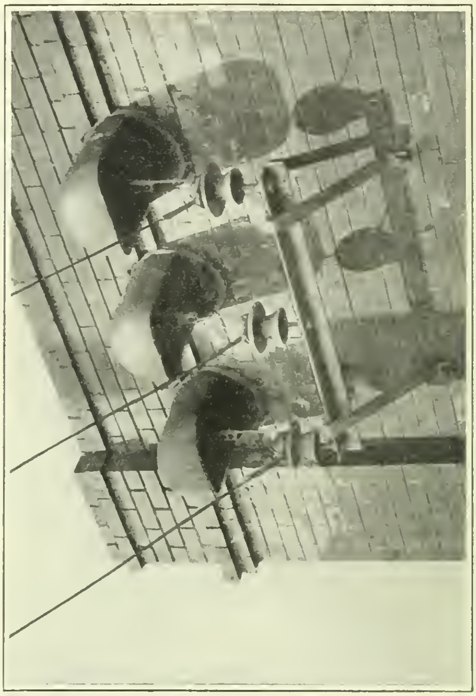


Fig. 19—Standard 13,200 Volt Entrance Hoods.

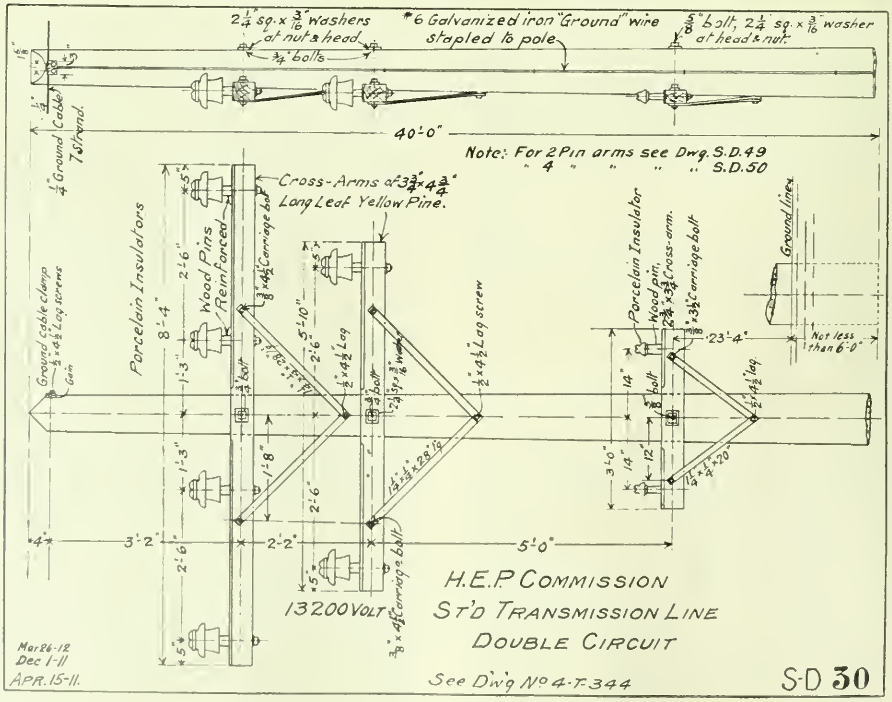


Fig. 17—Standard 13,200 Volt Pole Line.

high tension tower line is placed at one side of the right of way and the telephone line at the other side, leaving an approximate free space of thirty-nine feet between the two lines.

The towers on this line are sixty-seven feet high. As will be seen from the photograph, Fig. 9, the design is somewhat different from the former towers and as already stated the three wires constituting a circuit are placed vertically one over the other (tandem). The lowest cross arm of this tower is twenty feet two inches in length from tip to tip. The upper arms are slightly shorter. It will also be noted that on account of the arrangement of the transmission cables three cross arms are necessary instead of the two used in the former design.

The insulator units are practically identical with the former type only slight changes being made in the hardware. The standard insulator contains eight units as before but the strain insulators consist of two parallel insulators of ten units each connected together and to the line at one end and the tower at the other by two yokes. A clearance of nine feet between conductors on the same circuit is maintained throughout.

The longest span is 780 feet and the average about 660 feet. All the footings are placed seven feet in the ground as before, but on the St. Thomas to Windsor line all strain towers have concrete footings.

Two circuits of No. 3/0 copper are being installed on this line and will be given five complete transpositions in the total distance. Two ground wires are installed on the two shoulders shown at the top of the tower. These are 5/16 galvanized steel.

The telephone line is standard construction using 30-foot poles, No. 9 B. & S. wire with transpositions every fifth pole.

Kent

There are two high tension transforming stations in connection with the recent extension of the 110,000 volt line from St. Thomas westward to Windsor. These stations are located, one in the neighbourhood of Chatham, the other close to Windsor. The first is known as the Kent station, the other, at the end of the line, as the Essex station.

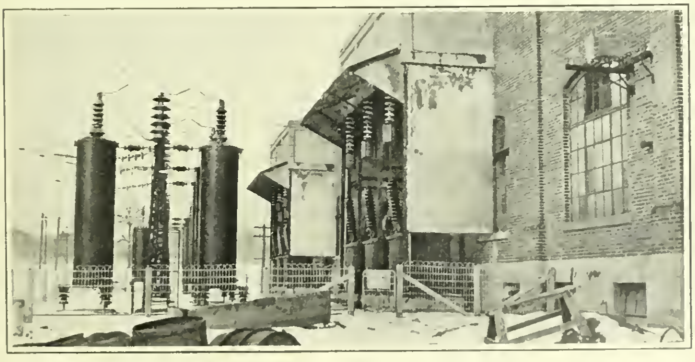


Fig. 20—Niagara Falls Station—High tension side.

The equipment installed in the Kent high tension station consists of four 1,250 kv.a. 110,000/26,400 volt oil-insulated, water-cooled transformers. These are connected in star on the high tension side and in delta on the low tension side.

The arrangement of the station is such that both 110,000 volt lines from St. Thomas enter the station and are connected through automatic oil circuit breakers to the main bus bars. The two outgoing lines which pass on to the Essex station are also provided with oil circuit breakers. Each of the two lines both on the incoming and outgoing sides is protected by an electrolytic lightning arrester.

The installation of the equipment in this station is not yet quite complete but there will be six 26,400 volt feeders to serve Chatham, Wallaceburg and other municipalities, which it is expected will use power in the near future, including Blenheim, Ridgetown, Thamesville, Bothwell and Dresden.

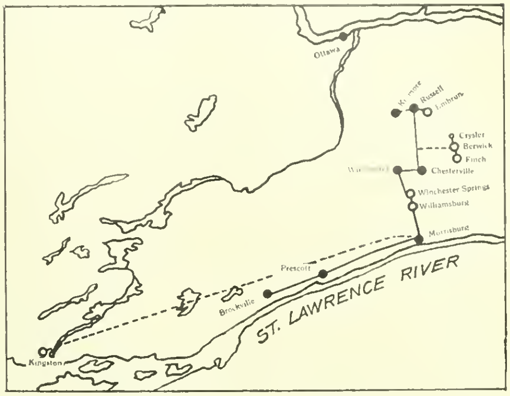


Fig. 21—Eastern section of Hydro distribution system.

Dresden will be supplied off the Wallaceburg line. Two extra 26,400 volt feeders will be required for the other service. The design of this station is shown in Fig. 11.

Essex

The Essex station which has been erected at Wallaceburg, just outside Windsor, is the western terminus of the 110,000 volt line. It is being used to serve Walkerville, Windsor and Sandwich and will serve other and surrounding municipalities in the near future. Both the 110,000 volt lines enter this station passing through automatic oil circuit breakers to the bus bars. Electrolytic lightning arresters are installed as in the other stations. The transformer equipment consists of four 2,500 kv.a. single-phase, oil-insulated, water-cooled, transformers, three being connected in a bank in star on the high tension side and in delta on the secondary side. The fourth transformer will be kept as a spare. The secondary voltage is 26,400. Six 26,400 volt feeder lines and equipments are installed. The equipment was supplied by the Can-

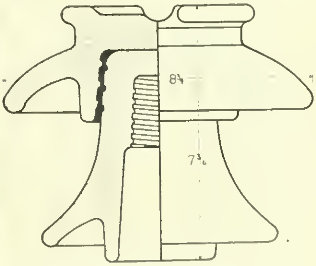


Fig. 22—Standard type 26,400 volt insulator.

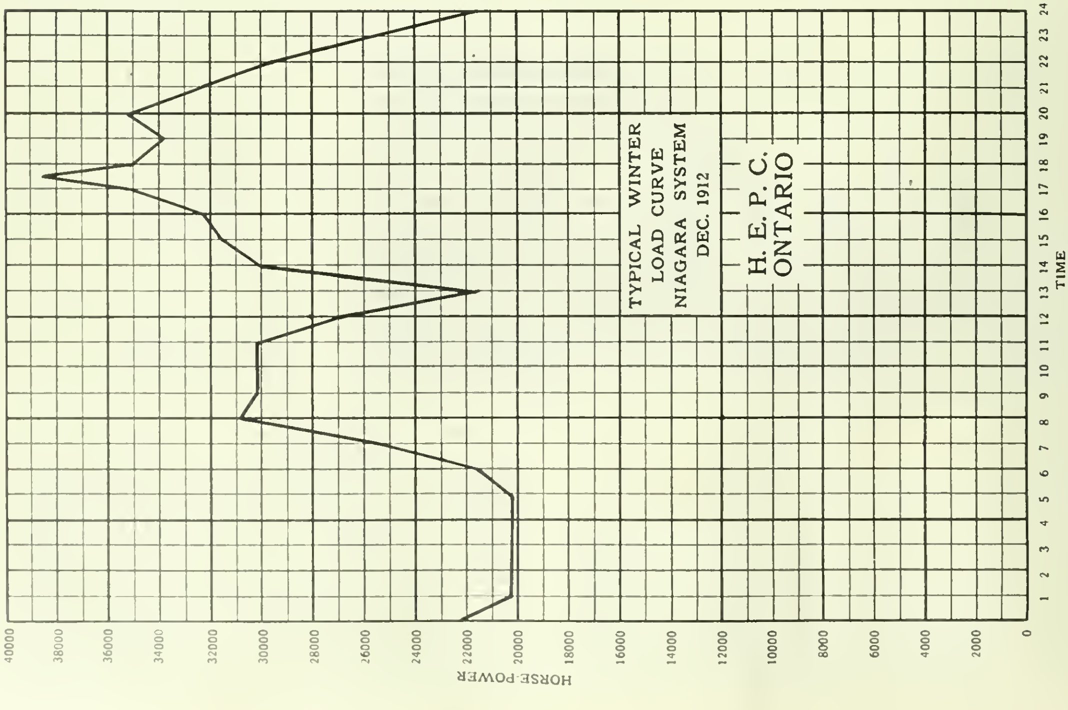


Fig. 23—Typical winter load curve, Niagara system.

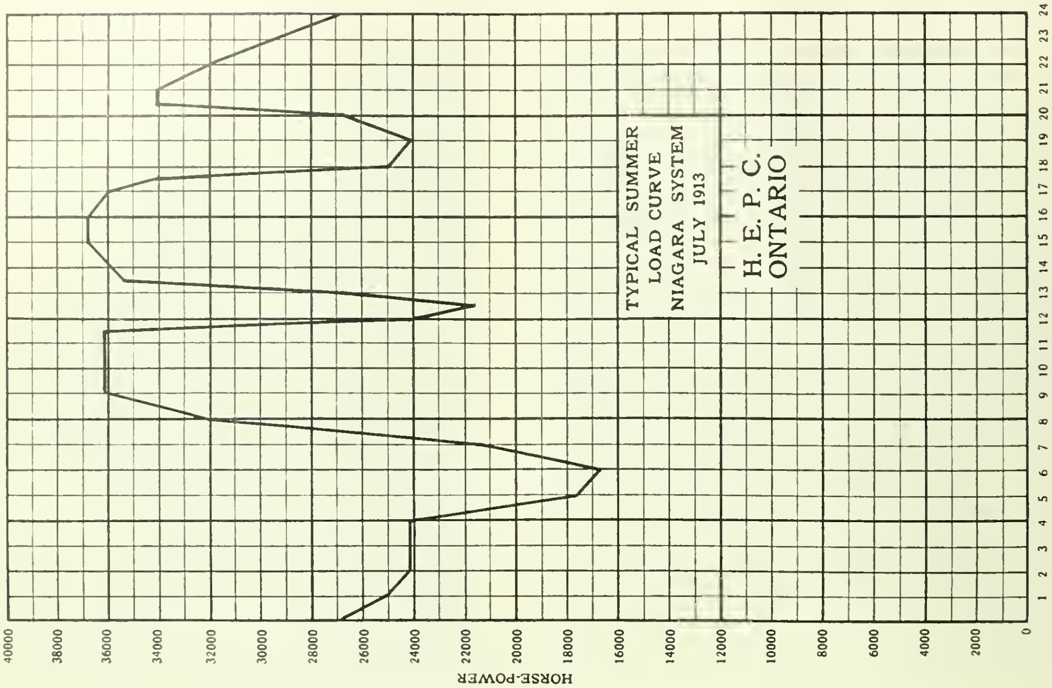


Fig. 24—Typical summer load curve, Niagara System.

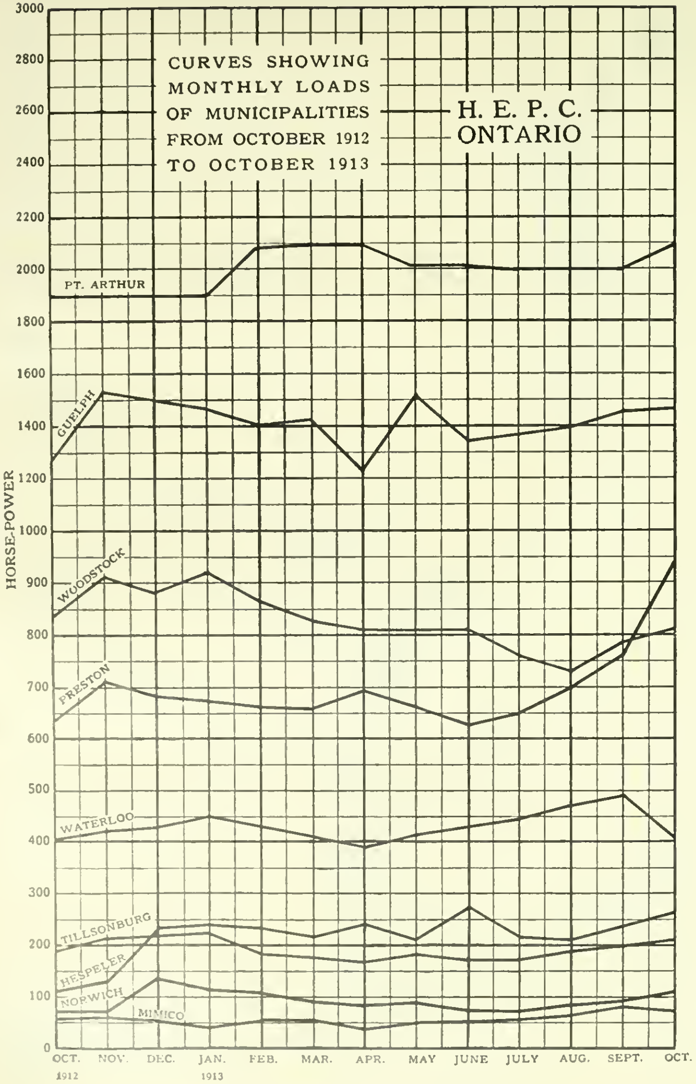


Fig. 25 Showing monthly load curves of different municipalities.

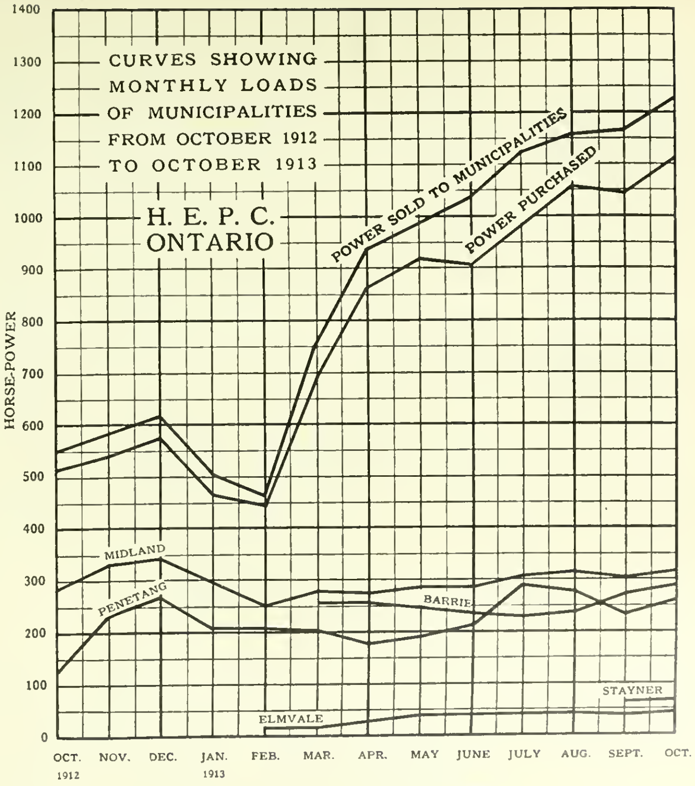


Fig. 26—Monthly load curves of municipalities.

Figs. 25 and 26 show the monthly load curves of a number of municipalities for the year ending October, 1913. The noticeable point is the overlapping of the load peaks. The maximum load has rarely been reached at the same time by any two municipalities. This affects the load factor of the system very favorably. It also enables the Commission to sell more power to the municipalities than they buy from the generating company. This is indicated by the two upper curves in Fig. 26, where it is seen that this gain has sometimes been in excess of 10 per cent.

adian Westinghouse Company. The general design of the station is shown in Fig. 16.

The Welland Line

A 46,000 volt, six circuit line is being installed at present between the Niagara Falls step-up station and the Welland district. This is a latticed steel tower line. The tower is 48 feet high over all, three feet square at the bottom and tapering to 1½ ft. square at the top. The towers carry four 4-pin cross arms and one 2-pin arm. The length of the 4-pin arm is 15 feet. These arms are spaced about four feet apart, the upper arm being two feet below the peak of the tower. The 2-pin arm is placed below the four 4-pin arms. The arms are of steel. The type of insulator used is a three unit suspension with four units in the strain insulators.

The footings of these towers are run seven feet into the ground and consist of an eight-foot block of concrete, i.e., seven feet underground and one foot above ground. The towers are spaced approximately 250 feet apart. One ground wire is installed on the peak of the tower line.

Six circuits are being installed to a distributing point in the neighborhood of Allenburg. From this point two circuits will be run to St. Catharines and four to the Union Carbide Company near Welland. The town of Welland will be supplied by a double line tapped off the line running to the Union Carbide Company, at the corner of Lincoln Street and Southworth Avenue.

Only a small portion of this line has yet been constructed but work is being pushed rapidly forward.

The Severn River System

On the 10th of February, 1911, the Hydro-electric Power Commission of Ontario entered into an agreement with the Simcoe Railway & Power Company to supply power under the following conditions:—for the initial 200 h.p. $21.00 per h.p. per annum; when the demand increased to 500 h.p. $20.00 per h.p. per annum; when the demand further increased to 1,000 h.p. $19.00 per h.p. per annum; when the demand increased to 1,500 h.p. $17.50 per h.p. per annum. This applied to delivery at 2,200 volts. If in any case the current is purchased at 22,000 volts the cost will be $1.00 less per h.p. per year.

The Simcoe Railway & Power Company have their own generating station at Big Chute. The design of this plant was described in detail in the January and February, 1913, numbers of the Electrical News. The plant is designed for five 900 kv.a. capacity 2,200 volt, 60-cycle, 3-phase, 300 r.p.m. generators. The turbines are double runner Francis type designed to develop 1,300 h.p. under a 56-foot head at 300 r.p.m. Power is generated at 2,200 volts and stepped up to 25,000 for transmission.

The power purchased from this company by the Commission is delivered to Port Severn, Waubaushene, Coldwater, Penetang, Midland, Elmvale, Barrie, Stayner, and Collingwood at 25,000 volts. A transmission line has also been constructed connecting the Big Chute plant with another plant at Ragged Rapids further up the Severn River and owned by the municipality of the town of Orillia. It is understood to be the intention of this municipality to replace the Ragged Rapids plant by another larger plant more advantageously situated both from the point of view of power development and in connection with the Trent Valley canal being constructed by the government.

The extent of this system is shown in the map, page 54 It will be seen from the dotted lines that ultimately it is the intention to connect the Big Chute plant with Wasdell's Falls on the east and Eugenia Falls on the west and through Eu-

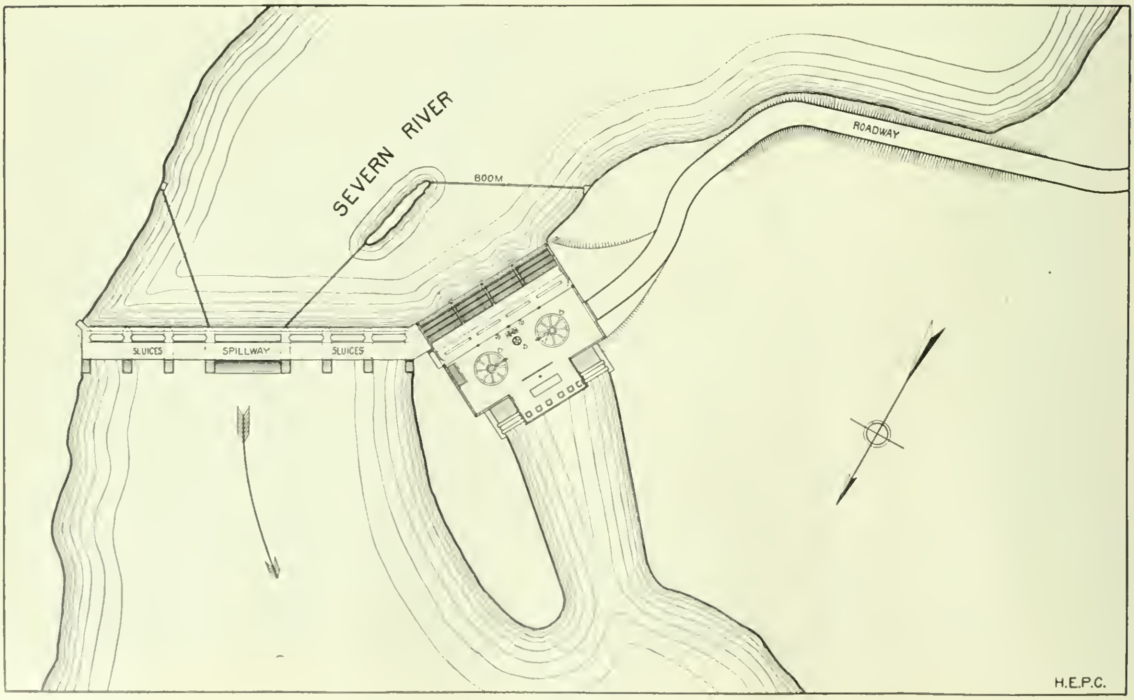


Fig. 27- Wasdell's Falls Development—General Lay-out.

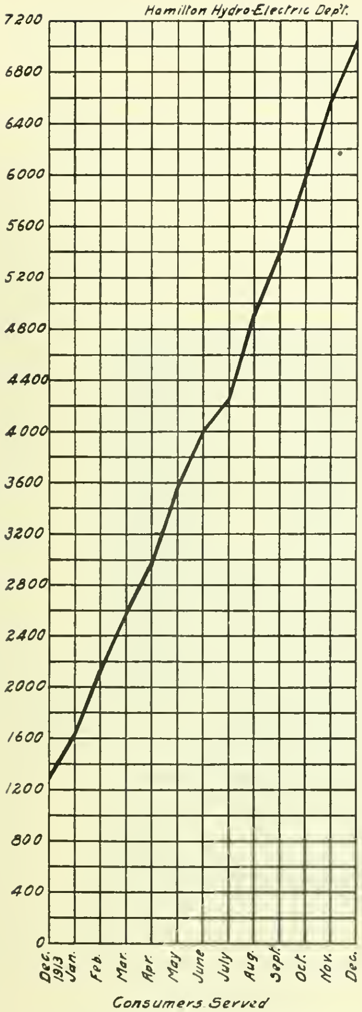


Fig. 28 Hamilton's prosperity curve.

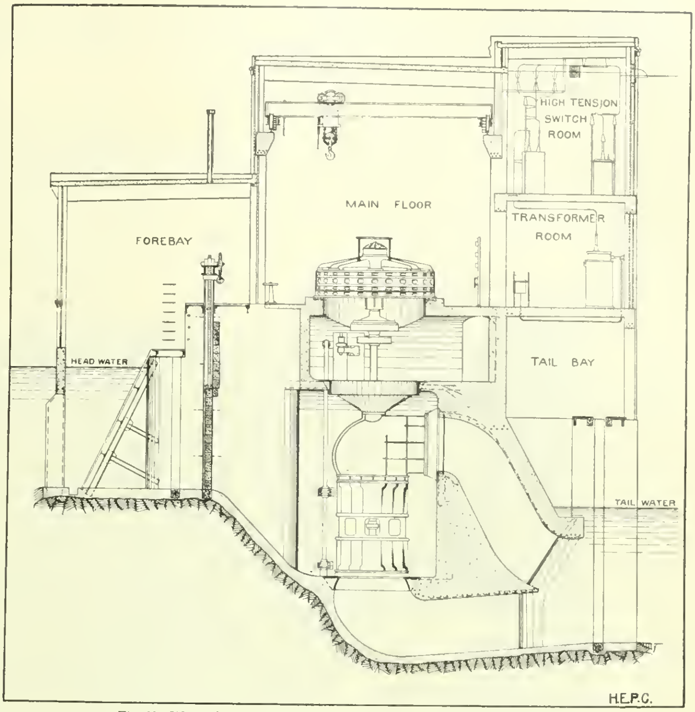


Fig. 29—Wasdell's Falls Development Cross Section through Power House.

genia Falls with the most northerly section of the Niagara Falls system.

Up to the present time local transformer equipment for this system has been installed as follows:—Barrie 700 kv.a.; Penetang 600 kv.a.; Collingwood 750 kv.a.; Coldwater 225 kv.a.; Elmvale 255 kv.a.; Stayner 300 kv.a.

The original equipment in the Penetang station was 400 kv.a. but owing to increased demand for power another 200 kv.a. single-phase, 60-cycle, 2,300 volt unit was added during the past year.

The Barrie installation consists of two 350 kv.a. single-phase transformers and 22,000 volt switching and protective apparatus. The old power station of the town is being used to house the equipment. The town itself has purchased potential regulators and power and lighting feeder panels required on their local system. There has also been placed in service a motor driven pump equipment for both domestic and fire service.

In Collingwood three 250 kv.a. transformers have been installed with switching and protective equipment. The town has built a new power station and purchased potential regulators and a motor driven pumping equipment. The secondary system in Collingwood is 2,300 volts, three-phase.

Three 75 kv.a. transformers are installed in Coldwater for stepping down from 22,000 volts three-phase to 2,300 volts three-phase. There is also a full complement of protective devices.

In the village of Elmvale there is installed three 75 kv.a. single-phase transformers and switching equipment for one 22,000 volt incoming line and one 2,300 volt outgoing line. The 22,000 volt protective equipment was supplied by the Siemens Company of Canada. A new station was constructed which is practically a duplicate of the Coldwater station.

The equipment in Stayner consists of three 100 kv.a. transformers supplied by the Canadian Westinghouse Company. Siemens' lightning arresters and choke coils are installed for 22,000 volt protection. These transformers are star connected with neutral grounded so as to give 4,000 volt, three-phase distribution.

Wasdell's Falls Generating Station

The first point at which the Commission have undertaken to generate power by the development of a waterfall is at Wasdell's Falls on the Severn River, just where the river leaves Lake Couchiching, the northern arm of Lake Simcoe.

Specifications were issued in May, 1913, covering complete electrical equipment for development at this point, and the contracts were awarded both for generators and exciters to the Swedish General Electric Company. The turbines were supplied by the Boving Company of Canada; the stop log winch and head-gate lifting mechanism by William Kennedy & Sons of Owen Sound; the over head crane by W. D.

Beath & Son. The dam and power house were constructed by Galbraith & Cate, Montreal. The transformers and complete switching equipment are being supplied by the Canadian Westinghouse Company.

A description of the electrical equipment follows:—There are two vertical type 400 kv.a., 3-phase, 60-cycle, 2,300 volt, 90 r.p.m. generators, each direct connected through a flexible coupling with a water wheel and each provided with a ball thrust bearing at the top of the generator frame. This bearing carries only the weight of the generator rotating parts. These generators have a 25 per cent. overload guarantee and are also guaranteed to withstand a test of 180 per cent. of normal speed for fifteen minutes with full excitation; also a short circuit at the terminals for one minute with the same excitation without injury to any part.

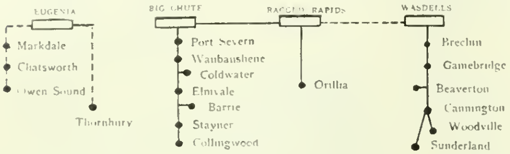


Fig 30—Towns served by Severn River and Eugenia.

Two compound wound, 125 volt, exciters are provided, one being turbine driven, and the other motor driven. The turbine driven exciter is rated at 20 kw., 190 r.p.m. and is capable of exciting both generators. The motor driven exciter is rated at 30 kw., 1,200 r.p.m. and is on the same base with and direct connected to a 45 h.p., 3-phase, 60-cycle, 220 volt squirrel cage induction motor. Both exciters are designed to be suitable for use with a Tirrill voltage regulator.

There are two banks of transformers, each consisting of three 150 kv.a. single-phase, self-cooled, oil-insulated units with high tension voltages of 22,000, 23,000, 24,000 and 25,000 volts, and with low tension voltages of 2,300, 2,200, 2,100, 2,000 and 1,900 volts. A spare transformer is also being supplied.

In addition to above transformers there are three 15 kv.a., 2,300/220-110 volt, single-phase service transformers for use in supplying the motor for driving the exciter and for station lighting.

The switchboard consists of seven panels of black slate, there being two generator panels, two exciter panels, one station service panel and two combined transformer and outgoing line panels. The 2,300 volt bus bars and oil switches are mounted on a separate framework, a short distance behind the panels. The two outgoing high tension transmission lines are controlled by Westinghouse automatic Type "E" 25,000 volt oil switches in the gallery, operated from the switchboard on the main floor. There is an aluminium cell lightning arrester installed for each of the two lines.

The scheme of connections is such that the station may be operated in two parts if required, since each bus is divided by disconnecting switches into two sections with one exciter, one generator, one bank of transformers and one transmission line on each section. The general design of the station is shown in Figs. 27 and 29. It will be noticed that the turbine is of the double runner type, vertical shaft. The present installation constitutes the total capacity of the fall. The head is 12 feet at maximum. It is the ultimate intention to connect this system up with the two other generating plants on the Severn River, namely the Big Chute and Ragged Rapids. The course to be followed by this connecting line has not yet been determined however. In the meantime power will be supplied to Woodville, Sutherland, Cannington, Beaverton, Gamebridge and Brechin, at each of which points there will be a small station to step the current down from 25,000 volts to 2,200 volts for local distribution.

Signed contracts have already been received from municipalities in this district covering a supply of 625 h.p.

Eugenia Falls

For some time past the Hydro-electric Commission have been endeavoring to work out a feasible scheme whereby electric power and light might be supplied to Owen Sound and the surrounding district. The best source of power in the neighbourhood has been located at Eugenia Falls on the Beaver River, which was owned until recently by the Georgian Bay Power Company.

Some delay in the negotiations between the town of Owen Sound and the Hydro Commission was caused by uncertainty of the minimum waterflow measurements of the Beaver River, and to this end a sharp crested weir was built at Eugenia Falls and a recorder employed for the purpose of making continuous flow measurements during the summer of 1913. The details of this investigation satisfied the commission and the town of Owen Sound that they were justified in entering into a mutual contract to supply 1,200 h.p. to the town of Owen Sound. The initial development will be approximately 4,000 h.p. in generating capacity, and the station will be planned for an ultimate 8,000 h.p. capacity. The head at this point will be the highest east of the Rocky Mountains, and in the neighbourhood of 550 feet.

Surveys have been made and excavation work is at present under way, looking to the completion of this plant early in the year 1915.

Morrisburg

An agreement has been entered into with the Rapids Power Company of Morrisburg for the supply of a quantity of power to be distributed by the Commission to different points in Eastern Ontario. Certain assistance was given this company with the purchase of the necessary stepping up transformer equipment to be installed in its generating station at Morrisburg, from which the current is sent out over the distributing lines at 26,400 volts. Power lines at this voltage have been constructed to Prescott and Brockville in a westerly direction and to a number of smaller towns due north of Morrisburg as far as Russell.

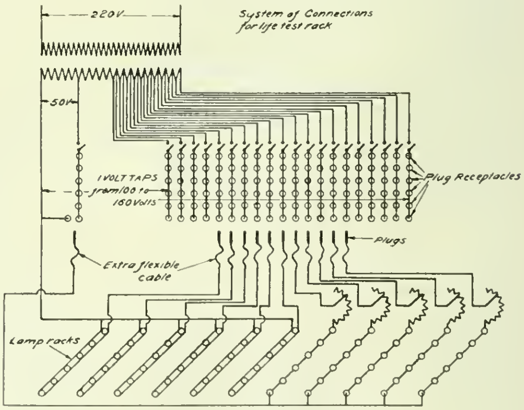


Fig. 31—Lamp Testing Diagram, Toronto Laboratory.

In the Prescott station there are installed three 150 kv.a. single-phase transformers, stepping down from 26,400 to 2,300 volts; also switching equipment for one 26,400 volt line and two 2,300 volt feeders. The 26,400 volt protective equipment was supplied by the Siemens Company and the other electrical equipment was installed by the Canadian General Elec-

tric Company. The local distribution and street lighting system have been reconstructed. Prescott enjoys the distinction of being the first town to receive power through the Commission from a development on the St. Lawrence River.

Rates in Prescott

The rates in Prescott, which are typical for this district, are as follows:—Power rate: a service charge of $1.00 per month per h.p. of connected load or maximum demand plus a consumption charge of 2.8c per kw.h. for the first fifty hours' monthly use, 1.8c for the second fifty hours' monthly use and .2c per kw.h. for all additional consumption. A 10 per cent. discount for prompt payment is allowed.

For domestic lighting a service charge of 4c per 100 sq. ft. plus a consumption charge of 4c per kw.h. with 10 per cent for prompt payment is given. There is a minimum charge of 25c per month.

For commercial lighting a rate of 8c per kw.h. is charged for the first 30 hours' use and 4c per kw.h. for all additional consumption with a prompt payment discount of 10 per cent. and a minimum charge of 50c.

The village of Winchester has signed an agreement with the Commission to take 100 h.p. at an estimated cost of $24.00 per h.p. per year. The by-law authorizing debentures for the necessary expenditures was carried by a vote of 154 to 4, which indicates the enthusiasm of that district over Hydro-electric power.

The village of Chesterville carried a $5,000 by-law by 111 to 21, and later signed a contract covering a supply of 50 h.p. at an estimated cost of $35.00 per h.p. per year.

An agreement with the town of Russell calls for the supply of 300 h.p. at an estimated cost of $33.87 per h.p. per year. The town has passed a by-law to expend $7,000.

Construction is well under way at all points where by-laws have been carried, and it is expected other towns and villages will be served in the near future. Reference to the map, Fig. 21 indicates the probable extent of the operations in this district in the near future. It will be noted that a projected line runs to Kingston. No contract has been closed as yet, but negotiations have been proceeding for sometime between the Commission and that city, and it is expected that some arrangements will be reached in the near future whereby Kingston can be served with power from the St. Lawrence River.

With the increased demands in this district it was evident that the supply available at the plant of the Rapids Power Company would soon be inadequate, and a contract has been closed by the Commission to obtain further supply from a plant at present under construction at Waddington Falls. The generating company agree to deliver the power to the national boundary, at which point the Commission will become responsible. It is believed that the power obtained in this way will be sufficient for sometime, and until some larger scheme of development of the St. Lawrence River has been decided upon.

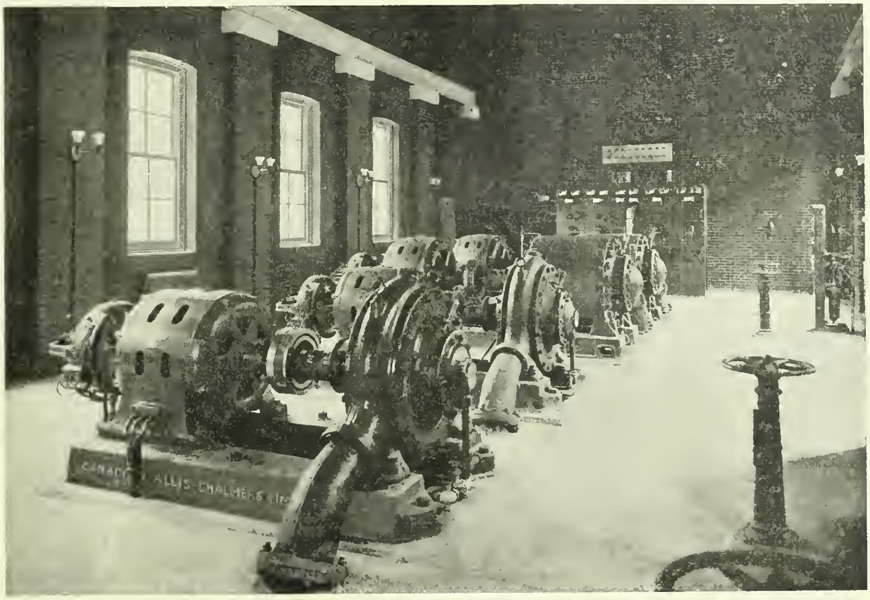


Fig. 32—Hamilton's Pumping Station.

Port Arthur

Power is purchased by the Ontario Commission from the Kaministiquia Power Company and supplied to the city of Port Arthur. The Commission constructed a 22,000 volt line and a 22,000/2,300 volt station and the original equipment had a capacity of 2250 kw. During the past year, however, work was completed on an additional section to the power house and the capacity is now 5,250 kv.a. including 2,200 volt service for commercial, street and house lighting, 600 volt lines for power service and a 750 kv.a. motor-generator set for street railway work.

Port Arthur has two local sub-stations and during the past year have erected a new pumping station in connection with the municipal waterworks plant.

The rate covering the purchase of power from the Kaministiquia Power Company is $16.00 which after transmission charges costs the municipality $19.50 for the amount now taken.

The extent of the transforming capacity installed and

controlled by the Ontario Commission is given in detail in Table I. As indicating the rate at which capacity is being added, Table II. is a list of transformers purchased during the year ending October 31, 1913. It is to be understood that Table I. does not include purchases made by the municipalities, that is, for that class of station known as a "municipal station" defined earlier in this description. It refers only to high tension stations and "distributing" stations.

TABLE I.
TRANSFORMER STATION CAPACITIES

Niagara System	25 Cycle Voltage	Total Kv-A.
1. Niagara Transformer Station	12,000-110,000	52,500
	12,000- 46,000	21,000
2. Dundas Transformer Station	110,000- 13,200	7,500
Caledonia Dist. Station	13,200- 2,300	450
Waterdown Dist. Station	13,200- 2,300	225
Hagersville Dist. Station	13,200- 2,300	225
3. Toronto Transformer Station	110,000- 13,200	25,000
4. London Transformer Station	110,000- 13,200	5,000
Dorchester Dist. Station	13,200- 4,000	75
5. Guelph Transformer Station	110,000- 13,200	3,000
Acton Dist. Station	13,200- 2,300	225
Georgetown Dist. Station	13,200- 4,000	225
Rockwood Dist. Station	13,200- 2,300	75
6. Preston Transformer Station	110,000- 6,600	4,500
Breslau Dist. Station	6,600- 2,300	225
7. Berlin Transformer Station	110,000- 13,200	4,500
New Hamburg Dist. Station	13,200- 2,200	225
Baden Dist. Station	13,200- 2,300	225
Elmira Dist. Station	13,200- 4,000	225
8. Stratford Transformer Station	110,000- 13,200	3,000
	110,000- 26,400	5,000
9. St. Mary's Transformer Station	110,000- 13,200	3,000
St. Mary's Cement D.S.	13,200- 575	1,500
10. Woodstock Transformer Station	110,000- 13,200	3,000
Norwich Dist. Station	13,200- 2,300	150
Beachville Dist. Station	13,200- 2,300	150
11. St. Thomas Transformer Station	110,000- 13,200	3,000
Port Stanley Dist. Station	13,200- 2,300	150
12. Cooksville Transformer Station	110,000- 13,200	5,000
Mimico Dist. Station	13,200- 2,300	225
Port Credit Dist. Station	13,200- 2,300	225
Cooksville Dist. Station	13,200- 2,300	50
Streetsville Dist. Station	13,200- 4,000	225
13. Brant Transformer Station	110,000- 26,400	5,000
14. Kent Transformer Station	110,000 26,400	5,000
15. Essex Transformer Station	110,000- 26,400	10,000
		170,075
Severn System	60 Cycle	
Penetang District Station	22,000- 2,200	600
Barrie District Station	22,000- 2,300	700
Collingwood District Station	22,000- 2,300	750
Coldwater District Station	22,000- 2,300	225
Elmvale District Station	22,000- 2,300	225
Stayner District Station	22,000- 4,000	300
		2,800
St. Lawrence System		
Prescott Dist. Station	26,400- 2,300	450
		450
Port Arthur System		
Port Arthur Dist. Station	22,000- 2,200	5,250
		5,250
Wasdell's Falls System		
Power House	2,300/22,000	1,050
		1,050
Grand Total		179,625

The capacity of spare transformers is included in the above.

Ottawa

In Ottawa power is purchased by the Ontario Commission from the Ottawa & Hull Power Company which operates within the corporation limits. The rate paid to the Ottawa company is $15.00 per h.p. year.

The original contract was for 1,500 h.p. which was later increased to 2,500 and later to 4,000. At the present time negotiations are proceeding looking to an arrangement whereby a still greater quantity of power may be obtained for Ottawa. It has been thought that a separate plant may be installed by the Commission at Chats Falls but this matter is still held in abeyance pending the result of arbitration proceedings on the price of this power site. New consumers are being added in Ottawa at a very rapid rate. At December 31, 1913, Ottawa had 5,766 domestic light customers, 818 commercial light customers and 152 power customers

TABLE II.
STATION TRANSFORMERS PURCHASED
For Municipalities and Commission during fiscal year ending Oct. 31, 1913

Station	Frequency	Voltage	No.	Capacity	Total Kv-A.
Niagara Falls Trans. Stat.	25	12,000/110,000	3	3,500	10,500
	25	12,000/ 46,000	6	3,500	21,000
Dundas Transforming Stat.					
Corporation of Dundas...	25	13,200/2,300/575	3	150	450
Hagersville Dist. Station.	25	13,200/2,300/575	3	75	225
Toronto Transforming Stat.	25	110,000/13,200	3	2,500	7,500
Guelph Transforming Station.					
Central Prison Farm ...	25	13,200/2,300/575	3	100	300
Georgetown Dist. Station.	25	13,200/2,300/575	3	75	225
Rockwood Dist. Station..	25	13,200/2,300/575	3	25	75
Preston Transforming Stat.					
Corporation of Preston..	25	13,200/2,200	3	170	510
Corporation of Galt	25	13,200/2,200	3	150	450
Breslau Dist. Station ...	25	13,200/2,200	3	75	225
Berlin Transforming Stat.					
Corporation of Berlin....	25	13,200/2,200	3	250	750
Elmira Dist. Station ...	25	13,200/2,200	3	75	225
Baden Dist. Station	25	13,200/2,200	3	75	225
Stratford Transforming Stat.	25	110,000/26,400	4	1,250	5,000
Corporation of Clinton ..	25	26,400/2,300/575	3	150	450
Corporation of Goderich.	25	26,400/2,300/575	3	250	750
London Transforming Stat.					
Dorchester Dist. Station.	25	13,200/2,300/575	3	25	75
St. Thomas Trans. Station.					
Corporation of St. Thomas.	25	13,200/2,300/575	3	100	300
Corporation of St Thomas.	25	13,200/2,300/575	3	150	450
Cooksville Trans. Station.					
Corporation of Milton...	25	13,200/2,300/575	3	250	750
Streetsville Dist. Station.	25	13,200/2,300/575	3	75	225
Brant Transforming Station.	25	110,000/26,400	4	1,250	5,000
Corporation of Brantford.	25	26,400/2,300/575	2	750	1,500
Corporation of Paris	25	26,400/2,300/575	3	200	600
Kent Transforming Station.	25	110,000/26,400	4	1,250	5,000
Essex Transforming Station	25	110,000/26,400	4	2,500	10,000
Penetanguishene Dist. Stat..	60	22,000/2,200	1	200	200
Elmvale Dist. Station	60	22,000/2,300	3	75	225
Stayner Dist. Station.	60	22,000/2,300	3	100	300
Wasdell's Falls Power Stat.	60	2,300/22,000	7	150	1,050
Prescott Dist. Station	60	26,400/2,300/575	3	100	300
Total					74,835

Hydro in Preston

(Contributed)

The electric business of the Town of Preston is managed by the Preston Light & Water Commission. In 1910 work was commenced to put the system in shape to handle hydro-electric power. Improvements and extensions have been made yearly since and during this time $62,000 has been spent on capital account. Our maximum demand of power purchased from the Hydro Commission is 951 h.p., and our original contract with the hydro was for 600 h.p. with the privilege of reducing to 300 h.p.

In 1910 we installed three 170 kva. station transformers and in 1913 we duplicated the transformer capacity of the station. We serve power to 29 customers with a maximum demand of 1120 h.p. At the present time we have 695 lighting customers. This is an increase of 401 since hydro was installed, and 200 of the increase were installed in 1913. The number of lighting customers is steadily increasing.

Rates are as follows:—

Power rates: $1.00 per h.p. per month and 2.3c, 1.6c and .2c less hydro standard class discounts and a prompt payment discount of 20 per cent.

Commercial lighting: 8c for first 30 hours' use of installed capacity and 4c additional less prompt payment discount of 20 per cent.

Domestic lighting:4c per 100 sq. ft. of area lighted and 4c per kw.h. less prompt payment discount of 20 per cent.

Street lighting: $12.00 per year for 100 watt lamp; $11.00 per year for 50 watt lamp.

We pump our water by centrifugal pumps operated by electricity which costs us 60 per cent. of what steam power would cost. Lamps are sold by us to the consumer at 10 per cent. above cost. Hydro electric power is popular with the people of Preston. Our population is 5,000.

During the year a 6,600 volt line has been installed to serve the Doon Twines, Limited, Doon. This line was built by the Ontario Commission but later taken over and is now operated by the local commission.

Commercial Development and Success

The success of the commercial side of this great enterprise is indicated by the tremendous extension of the past twelve months which aggregates some 75,000 kv.a. capacity in transformers of all sizes, Table II. The actual growth in demand during the last three and a half years is also indicated in a very definite manner by the chart in Fig. 33 which indicates the rapid increase of the total power consumption of the various municipalities served by the Ontario Commission.

This figure starts with May, 1911, when the power load was approximately 8,000 h.p. In one year this had increased to 20,000 h.p., in two years it had reached about 38,000 h.p. and during the peak of the past winter, which occurred in December, 1913, a total of 48,614 h.p. was reached.

The slight fall in the total power consumption following the peak load of December in both 1912 and 1913 is easily accounted for by the increased amount of daylight and the consequent smaller consumption of power for lighting purposes.

TABLE III.

Municipality	Load in h.p. Oct. 1912	Load in h.p Oct. 1913
Toronto	13036.5	17997.5
London	2681	3385
Guelph	1273.5	1488
Stratford	643.5	791
Mitchell	221	201
St. Thomas	643.5	1173
Woodstock	837.5	808.5
Ingersoll	496	469
Tillsonburg	194.5	208
Berlin	1226.5	1434.5
Waterloo	402	409
New Hamburg	107	153
Preston	643.5	931.5
Galt	643.5	1025.5
Hespeler	107	254.5
St. Mary's	261	368.5
Dundas	127.5	268
Hamilton	2044	3639.5
Hamilton Asylum	87	80.5
Weston	100.5	151.5
Brampton	382	474.5
Norwich	67	104.5
Seaforth	174	214.5
Waterdown	40	41.5
Ontario Agricultural College	114	129
London Asylum	67	120
Pt. Stanley	40	73
Baden	13.5	165
Mimico	50	71
Beachville	27	100.5
Pt. Credit	24	33.5
Caledonia	13.5	32

As indicating the load increases throughout the Niagara system, Table III., is interesting. It gives the h.p. load of a number of municipalities on October, 1912, and one year later on October, 1913. The increase is a very substantial one in practically every case and in some instances the load is more than doubled. Since that date the increases have been of about the same order.

Total Cost of System

The last financial report issued by the Commission gives the total capital expenditures on the different distribution systems up to October 31, 1913. These are as follows:—Niagara, $5,190,858.98; Port Arthur, $90,425.26; Morrisburg system, $93,666.02; Severn system, including Wasdell's Falls development, $250,099.48; sundries, $290,674.87; grand total, $5,915,724.51. Since that date, however, work has been vigorously pushed forward and the total expenditure either incurred or contracted for is now somewhere between $7,500,000 and $8,000,000.

It is to be understood, too, that this is the expenditure of the Commission alone. As already indicated the towns and cities purchase their own equipment and build their own sub-stations, only the villages being financed by the Provincial Commission.

The expenditures of the forty-five largest municipalities up to December 31, 1913, which covers practically the whole expenditure to that date total $9,119,008.59. Interesting figures are given in this connection in Table IV., which shows the plant cost, debentures and over draft, operation and maintenance, fixed charges, revenue, surplus, depreciation, number of customers, etc., up to the end of 1913. It will be seen that Toronto has made by far the largest expenditure, their total being $4,569,620.90. Ottawa comes next with nearly three-quarters of a million, London next with well over half a million, Hamilton and Port Arthur practically the same, Berlin over quarter of a million, and a half dozen other places well over the hundred thousand mark. It is interesting to note that the total number of customers of all kinds served by these forty-five municipalities at date December 31, 1913, was 65,697.

The Rates

The rates charged the different municipalities by the Commission and the rates charged consumers by the muni-

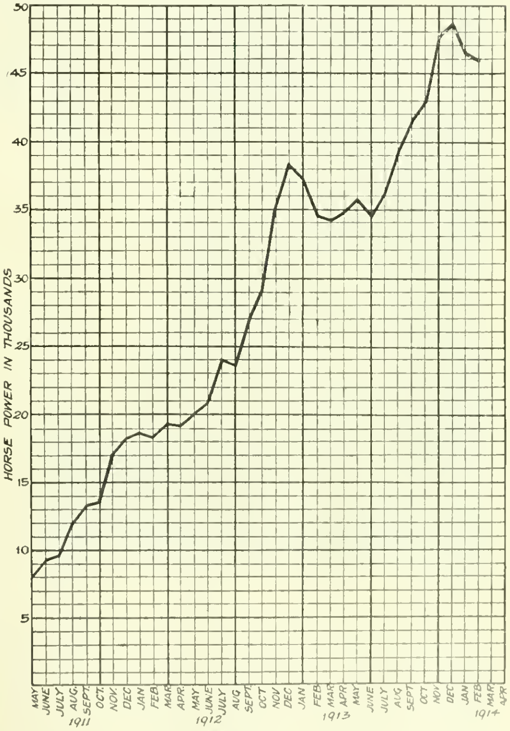


Fig. 33. Showing increase in total load on the Niagara system.

cipalities are possibly the most interesting features of the whole hydro-electric scheme. Table V. gives information with reference to municipal street lighting showing the cost of arc lights, the cost of incandescents and in the last column the cost per head of population per year of the street lighting. This has only been worked out for about half of the municipalities but sufficient data is given in this

TABLE IV.

Municipality	Plant Cost	Debentures and Overdraft	Operation and Maintenance	Fixed Charges	Total Operation	Revenue	Gross Surplus	Depreciation	Net Surplus	Number of Customers			
										House	Comm'l	Power	Total
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.				
Toronto (a)	3,919,809 80	5,149,803 65	670,082 78	239,951 08	910,033 86	1,151,128 89	241,095 03	(b)91,819 92	149,275 11	16,519	4,764	1,037	22,320
Ottawa	703,122 64	500,000 00	111,322 00	30,961 54	142,283 54	191,648 64	49,365 10	24,000 00	25,365 10	5,766	829	141	6,736
Hamilton (a)	546,437 11	486,468 13	74,514 40	17,416 18	91,930 58	110,496 42	18,665 84	(k) 8,697 09	9,968 76	5,117	924	209	6,250
London	590,769 16	481,900 00	126,323 86	28,831 47	155,155 33	192,224 47	37,069 14	21,716 32	16,352 82	5,201	1,007	198	6,406
Berlin (g)	267,225 80	257,659 13	51,292 70	17,897 45	69,190 15	94,555 19	25,365 04	10,980 79	14,384 25	1,291	470	127	1,888
Port Arthur (a)	545,902 57	496,500 00	68,282 71	38,409 37	106,692 08	171,514 02	64,821 94	(b)	64,821 94	3,409	500	55	3,964
St. Thomas	143,263 93	94,039 74	41,561 36	7,402 65	48,964 01	75,124 04	26,160 03	6,900 00	19,260 03	951	329	70	1,350
Guelph	153,453 06	119,084 02	47,294 58	10,273 27	57,567 85	80,726 82	23,158 97	8,000 00	15,158 97	1,260	400	85	1,745
Stratford	163,431 50	121,663 83	31,808 58	10,536 75	42,345 33	55,983 70	13,638 35	3,420 00	10,218 35	1,084	367	92	1,543
Galt	181,124 22	151,084 42	23,563 01	9,721 64	33,284 65	45,233 73	11,949 08	8,400 00	3,549 08	1,122	353	65	1,540
Woodstock	132,354 04	78,527 12	28,598 86	6,853 83	35,452 69	46,859 86	11,407 17	5,827 40	5,579 77	636	282	55	973
Collingwood	52,534 04	37,950 42	13,492 17	4,277 77	17,769 94	21,181 64	3,411 70	2,390 00	1,021 70	477	220	18	715
Barrie	98,905 03	55,755 06	17,540 63	5,590 40	23,131 03	27,245 02	4,113 99	3,350 00	763 99	763	200	13	976
Welland	70,944 83	64,016 63	6,660 53	711 19	7,371 72	7,630 34	258 62	(c)	258 62	408	53	18	479
Ingersoll	87,864 29	75,135 90	16,313 16	5,337 25	21,650 41	30,176 00	8,525 59	2,862 00	5,663 59	278	170	44	492
Midland	72,476 09	42,997 23	9,289 07	4,134 55	13,423 62	21,362 56	7,938 94	2,950 00	4,988 94	491	172	25	688
Waterloo (g)	77,121 17	53,507 14	17,830 01	3,675 97	21,505 98	29,626 32	8,120 34	3,100 00	5,020 34	321	125	44	490
Dundas	49,549 90	48,055 62	6,001 12	1,970 14	7,971 26	11,300 43	3,329 17	1,508 00	1,821 17	377	134	27	538
Preston	90,619 88	77,157 29	21,468 32	4,120 54	25,588 86	34,688 57	9,099 71	2,924 00	6,175 71	526	151	28	705
Penetang	41,031 38	29,490 67	9,319 95	2,035 90	11,355 85	17,318 91	5,963 06	1,820 00	4,143 06	128	91	15	234
St. Mary's	64,415 89	49,555 89	14,183 25	4,616 15	18,799 40	20,173 22	1,373 82	3,200 00	(d)*1,826 18*	396	160	29	585
Brampton	61,005 66	67,793 85	13,934 43	3,781 62	17,716 05	23,661 98	5,945 93	2,500 00	3,445 93	643	138	16	797
Tillsonburg	36,573 97	34,971 45	10,247 52	2,137 07	12,384 59	16,001 19	3,616 60	1,782 75	1,833 85	254	143	17	414
Hespeler	29,134 71	30,019 91	9,018 45	2,140 19	11,158 64	10,418 05	(e) *740 59*	1,450 00	(d)*2,190 59*	174	76	11	261
Seaforth	23,537 49	24,090 67	10,190 52	1,653 65	11,845 17	14,388 08	2,542 91	1,300 00	1,242 91	178	105	10	293
Weston	29,135 16	18,626 50	7,531 92	1,588 48	9,120 40	13,836 79	4,716 39	1,390 00	3,326 39	360	34	6	400
Milton	24,177 73	23,145 10	5,112 43	1,582 93	6,695 36	9,867 10	3,171 74	900 00	2,271 74	110	74	6	189
Mitchell	27,103 21	11,684 02	8,320 90	2,224 07	10,544 97	13,459 54	2,914 57	1,150 00	1,764 57	179	85	16	280
Georgetown	18,014 48	20,000 00	972 91	484 33	1,457 24	2,280 35	823 11	300 00	523 11	160	120	5	285
Acton	10,935 05	10,748 00	3,022 37	1,124 06	4,146 43	4,409 45	263 04	500 00	(d) *236 96*	82	62	3	147
New Hamburg	23,727 21	17,751 94	6,724 08	1,170 92	7,895 00	11,424 57	3,529 57	900 00	2,629 57	142	63	8	213
Mimico	15,607 08	14,685 80	2,174 95	845 02	3,019 97	3,803 55	783 58	740 00	43 58	250	....	5	255
Port Dalhousie	11,043 46	11,957 44	3,970 83	814 89	4,785 72	5,336 49	550 77	450 00	100 77	238	....	3	241
Norwich	14,285 41	14,467 36	4,272 92	886 40	5,159 32	6,400 52	1,241 20	500 00	741 20	166	76	3	245
Hagersville	6,558 31	6,000 00	1,004 92	97 60	1,102 52	1,128 77	26 25	(c)	26 25	3	24	3	30
Baden	5,540 63	4,843 68	3,103 33	325 26	3,428 59	3,957 83	529 24	277 00	252 24	75	....	2	77
Stayner	10,018 67	8,755 34	202 00	340 82	542 82	612 25	69 43	(c)	69 43	120	30	2	152
Caledonia	4,871 81	4,410.95	783 78	328 09	1,111.88	1,458 94	347 06	250 00	97 06	17	16	1	34
Coldwater	7,710 77	7,000 00	644 86	455 36	1,100 22	1,514 87	414 65	350 00	64 65	48	32	2	82
Port Stanley	19,642 58	18,153 58	4,522 20	1,188 91	5,711 11	8,217 86	2,506 75	617 75	1,889 00	182	60	9	251
Elmvale	7,423 01	6,894 64	589 31	299 76	889 07	933 65	44 58	(c)	44 58	52	52	1	105
Waterdown	7,373 96	6,303 41	1,420 16	521 56	1,941 72	2,516 94	675 22	365 00	210 22	70	34	2	106
Rockwood	5,526 51	6,034 13	281 96	225 99	507 95	907 09	399 14	(c)	399 14	48	9	1	68
Beachville	8,361 27	6,360 00	4,729 61	518 86	6,248 37	6,762 21	1,613 84	625 00	988 84	45	....	4	49
Port Credit	9,533 02	7,268 56	1,625 95	534 23	2,060 18	3,507 81	1,447 63	446 00	1,001 63	93	21	2	116

Figures in italics denote credits. a; Does not include old plant account. b, c and d; No depreciation included. e; Conditions now improved. f; Full depreciation not allowed. g; Thirteen months. h; Depreciation at 2½ per cent. k; Depreciation 3 per cent.

table to indicate the satisfactory cost of street lighting in general over this system. No figures are available on the operation of the new magnetite arc lamp and it will be interesting to see the effect of this type, as also of the nitrogen filled tungsten, on the cost of operation per head.

Power Rates

As far as possible the power rates all over the hydro system have been standardized. There is, first, a service charge of $1.00 (generally) per month per h.p. of connected load or maximum demand. In the determination of what the maximum demand shall be in any particular case a considerable amount of latitude is necessarily allowed. It depends on the particular system followed by any municipality and it will depend, of course, on the particular installation, as, for example, in a woodworking plant where there may be a dozen individual motors aggregating say 100 h.p. and where perhaps only half of these are operating at any one time, it will be manifestly unfair to consider the maximum demand as equal to the connected load. This figure of the maximum demand having been determined, however, a practically uniform system of charging has been adopted. The maximum demand in a case like the above may be placed at 50 h.p. or less. In the larger municipalities this figure is generally arrived at by periodic tests, but the smaller municipalities are necessarily governed by past experience and by the good judgment of the superintendents and engineers in charge aided by such data as is available bearing on their special conditions.

In addition to the service charge there is a consumption charge (based on the meter reading) at a certain fixed rate for the first fifty hours' use of this maximum demand, a second and smaller rate for the consumption during the second fifty hours' use of this load, and a third and still smaller rate (usually very small) for all consumption over this amount. These rates vary, of course, with the different municipalities. Varying discounts are also given off the above charges depending upon the "class" of service to which the customer belongs. Class A means twenty-four hours unrestricted use of connected load or maximum demand, on which there is no class discount. Class B means twenty-four hours' restricted use on which there is a 10 per cent. class discount (the restricted hours are given below). Class C means 10 hours' unrestricted use on which there is a 10 per cent. class discount; and class D means ten hours' restricted use on which there is a 33 1/3 per cent class discount. The restricted hours are as follows:—October 15 to 31, 5.30 to 6.30 p.m.; November 1 to 30, 5.00 to 6.30 p.m.; December 1 to January 15, 4.30 to 6.30 p.m.; January 16 to February 15, 5.00 to 6.30 p.m.; February 16 to March 1, 5.30 to 6.30 p.m. A final discount for prompt payment is given on the total bill, the percentage depending on local conditions.

For example, take the case of Barrie. A power consumer pays a service charge per h.p. per month of $1.00 on his maximum demand load. He also pays for the first fifty hours' use of his maximum load at the rate of 3.6c per kw.h., and for the second fifty hours use 2.4c per kw.h., and for all additional .3c per kw.h. A 10 per cent discount is allowed off the total bill. We will suppose that the customer has a 10 h.p. maximum demand and that in any month his meter reads 1,400 kw. His bill would be as follows:—Service charge = $10.00; first fifty hours' use would cost 10 x ¾ x 50 x 3.6 = $13.50; second fifty hours' use would cost 10 x ¾ x 50 x 2.4 = $9.00; additional power 650 kw. at .3c = $1.95; total $34.45. If the customer were in the unrestricted twenty-four hour class he would get only a 10 per cent. discount for prompt payment making his bill $31.00. If he were in the twenty-four hour restricted class he would get 10 per cent. and 10 per cent. off, making his bill $27.90. In class C his bill would be

the same as in class B. In class D his discount is 33 1/3 per cent. and 10 per cent. making his bill $19.68.

Commercial Lighting Rates

The rate for charging for commercial lighting has also been standardized as far as possible. For the most part, a certain rate is given for the first thirty hours per month of installed capacity with a lower rate for all current used in

Table V.

	Estimated population	Street lt. revenue	No. arcs	No. incandescents	Cost per arc per year	Cost per incandescent per year	Cost per capita per year
Toronto . .	435,000	344,933.79	....	38200	....	100w. 9.00	.80
Ottawa . . .	95,600	43,199.57	690	2460	45	100w. 6.83	.45
				186		100w. 10.00	
						75w. 11.00	
London. . .	52,000	28,372.20	....	2868	....	100w. 12.85	.54
St. Thomas .	17,000	10,989.72	44	1200	55	9.00	.64
						60w. 5.00	
Port Arthur .	15,600	14,709.41	....	2147	....	100w. 8.30	.94
Berlin . . .	17,500	16,057.40	....	1756	....	100w. 9.11	.91
Guelph . . .	16,319	9,500.04	....	1000	....	100w. 9.50	.59
Galt	11,800	6,280.25	....	901	....	100w. 9.50	.54
				38		250w. 25.00	
Woodstock. .	10,154	7,160.00	....	655	....	100w. 10.00	.70
Collingwood .	7,600	3,802.84	....	385	....	12 00	.50
						80w. 12.50	
Ingersoll . .	5,149	4,262.03	....	323	....	60w. 12.00	.82
Midland. . .	6,200	3,463.07	16	220	50	100w. 13.50	.52
						100w. 10.00	
Waterloo . .	7,000	4,877.64	....	546	....	60w. 9.00	.70
						100w. 12.00	
Preston . . .	4,982	2,594.55	....	234	....	50w. 11.00	.52
Penetang . .	3,701	2,042.00	....	161	....	100w. 12.00	.55
St. Mary's. .	4,000	3,582.00	47	48	65	75w. 13.00	.90
Brampton . .	5,000	3,500.00	....	500	....	7.00	.70
Tillsonburg .	2,976	2,601.00	....	223	....	60w. 11.00	.87
Hespeler. . .	3,089	1,500.00	....	120	....	100w. 12.50	.50
						75w. 15.00	
Seaforth. . .	1,900	1,815.81	....	116	....	60w. 12.00	.95
Weston . . .	2,300	2,052.00	....	171	....	100w. 12.00	.90
Milton. . . .	2,000	1,200.00	....	150	....	100w. 8.00	.60
Mitchell. . .	2,000	1,675.00	....	87	....	100w. 13.80	.84
Acton. . . .	1,750	1,000.00	....	147	....	100w. 12.00	.58
New Hamburg.	1,624	1,827.00	....	200	....	100w. 9.00	1.13

excess. There are a few exceptions as for example Dundas which gives a certain rate for the first twenty-five hours use, another rate for the next seventy-five hours use and a third and very low rate for all in excess. Over the total area the first rate varies from 12c down to 6c for the different municipalities. The secondary rate varies from 6c down to 2c. The discounts vary from 10 per cent to 25 per cent. A list of commercial rates as at date December 31, 1913, is given in Table VI.

Residence Lighting

A service charge of 4c per month per 100 sq. ft. of floor area has been standardized plus a consumption charge depending on local conditions. There is practically no exception to the fixed rate of 4c. The meter rate varies from 2½c to 5c and averages about 3½ per kw.h. Some municipalities also give very liberal discounts. The rates as at December 31, 1913, are also given in Table VI.

Reductions from the above figures have been made in a number of cases to apply to the present year's operations. For example, St. Thomas' domestic lighting rate is now 4c and 2½c with 20 per cent off; Port Arthur's is 4c and 2½c with 10 per cent. off; Ottawa's is 4c and 2½c with 20 per cent off; London's is 4c and 3c with 25 per cent off; Preston 4c and 4c with 20 per cent off. In the majority of cases, however, the current year's rate has not yet been definitely determined.

Act as Consultants

Another feature of the Commission's work which has been greatly developed during the past year is in acting as consultants and advisers for any Ontario municipalities that may have any kind of electrical extension work in contemplation or under construction. As a result there is scarcely a town in Ontario where operations are municipally controlled that the Hydro-electric Commission have not had one of their engineers make a report on the plant. This is working towards greater efficiency of all these plants. It also means that the equipment being purchased is becoming much more rapidly standardized than would be possible were a less close relation existing between the municipalities. This service is rendered for all practical purposes free of charge and is eagerly sought and highly appreciated by municipalities not included in the zones actually served by the Ontario Commission's lines.

As examples we mention the assistance given to the city of Kingston in connection with their recent underground work; to the city of Peterborough in installing their magnetite arc lighting system for street illumination, and in Bracebridge where the power situation is being investigated with a view to supplying this town with more power. These are only isolated instances of a very large amount of work of an advisory nature being carried forward by the Commission's engineers.

Electric Railways

During the 1913 session of the Ontario legislature an act was passed which invests the Commission with power to inquire into and report on the cost of construction and opera-

Fig. 34. Silo filling by hydro power.

tion of electric railways in any locality in which electric power may be supplied by the Commission. The act also authorizes any municipal corporation to enter into an agreement with the Commission for the construction and operation of electric railways, or for the construction by the Commission and their operation by the municipalities.

As a result a very great amount of survey work has been carried out during the last twelve months. This work has been of a most accurate and complete character covering not only the cost of construction and operation of the line but taking into consideration also all the factors, as far as possible, which would be likely to influence the revenue provided by their operation. The surveys cover in the neighbor-

TABLE VI.

Municipality	Cost of Power to Municipality per h.p. per year 1912	1913	Power rates, 1913: Service charge per h.p. month	1st 50 hr. per month per kw-hr.	2nd 50 hr. per month per kw-hr.	All additional per kw-hr.	Prompt payment discounts	Lighting rates, 1913: Domestic Per 100 sq. ft.	Per kw-hr.	Commercial 1st 30 hr. per month per kw-hr.	All additional per kw-hr.	Prompt payment discounts
	$ c.	$ c.	$ c.	c.	c.	c.	%	c.	c.	c.	c.	%
Acton	.....	36 00	1 00	4.3	2.9	0.4	10	4	5	10	5	10
Baden	36 95	37 00	1 00	4.2	2.8	0.3	10	4	5	10	5	10
Barrie	.....	33 70	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Beachville	33 89	31 00	1 00	3.9	2.6	0.3	10	4	5	10	5	10
Berlin	25 00	22 50	1 00	2.5	1.7	0.2	10	4	4	8	4	20
Brampton	29 00	25 00	1 00	3	2	0.25	10	4	3	6	3	10
Caledonia	29 10	29 10	1 00	3.7	2.5	0.3	10	4	4	8	4	10
Coldwater	.....	28 00	1 00	3.2	2.1	0.3	10	4	4	8	4	10
Collingwood	.....	33 97	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Dundas	17 00	16 00	1 00	1.6	1.1	0.15	15	4	3	6c 1st 25 hr. 3c next 75 hr.	0.15	10
Elmira	.....	.....	1 00	4.7	3.1	0.4	10	4	5	10	5	10
Elmvale	.....	31 00	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Galt	25 00	22 00	1 00	2.3	1.6	0.2	25	4	4	8	4	25
Georgetown	.....	36 00	1 00	4.3	2.9	0.4	10	4	5	10	5	10
Guelph	25 00	22 00	1 00	2.3	1.6	0.2	25	4	4	8	4	20
Hagersville	.....	33 21	1 00	3.9	2.6	0.3	10	4	4.5	9	4.5	10
Hamilton	17 00	16 00	1 00	2.1	1.4	0.2	25 & 10	4	3	6c 1st 25 hr. 3c next 75 hr.	0.2	20
Hespeler	26 00	23 00	1 00	3	2	0.25	10	4	4.5	10	10	10
Ingersoll	28 00	25 50	1 00	3.3	2.0	0.3	10	4	4.5	9	4.5	10
London	28 00	24 00										
Mimico	30 74	30 00	1 00	3.6	2.4	0.3	10	4	4	9	4.5	10
Milton	.....	28 00	1 00	3.1	2.1	0.3	10	4	4	8	4	10
Midland	21 00	20 30	1 00	1.7	1.1	0.15	10	4	4	8	4	20
Mitchell	38 00	37 00	1 00	4.5	3.1	0.4	10	Special rates 70c per. mo. minimum.				
New Hamburg	32 00	32 00	1 00	4.2	2.8	0.3	10	4	5	10	5	10
New Toronto	.....	.....	1 00	3	2	0.25	10	4	4	8	4·	10
Norwich	30 00	32 00	1 00	3.5	2.3	0.3	10	4	4	12	4	10
Ottawa	15 00	15 00										
Penetang	28 80	26 50	1 00	1.7	1.1	0.15	10	4	4	8	4	10
Petersburg	..... Served by Baden		1 00	5.1	3.4	0.4	10	4	6	12	6	10
Port Arthur	20 30	19 50	1 00	2.25	1.75	1.0	..	4	3.5	8	3.5	10
Port Credit	36 79	31 00	1 00	3.7	2.4	0.3	10	4	4.5	9	4.5	10
Port Dalhousie	....	22 30	1 00	2.1	1.4	0.3	10	4	3	6	3	10
Port Robinson	....Served by W'll'nd		1 00	1.8	1.2	0.15	10	4	3	6	3	10
Port Stanley	59 75	55 50	1 00	5.5	3.7	0.5	10	4	5	10	5	10
Preston	25 00	21 50	1 00	2.3	1.6	0.2	10	4	4	8	4	10
Rockwood	.....	38 00	1 00	4.7	3.1	0.4	10	4	5.5	11	5.5	10
Seaforth	41 00	40 00	1 00	4.9	3.3	0.4	10	4	5	10	5	10
Sebringville	....Served by Str'tf'rd		1 00	5.4	3.6	0.4	10	4	5	10	5	10
St. Agatha	..... Served by Baden		1 00	5.1	3.4	0.4	10	4	6	12	6	10
Stayner	.....	.....	1 00	4.7	3.1	0.4	10	4	5	10	5	10
St. Mary's	38 00	29 50	1 00	3.6	2.4	0.3	10	4	5	10	5	10
St. Thomas	32 00	29 00	1 00	3.3	2.0	0.3	10	4	4	8	4	10
Stratford	32 00	30 00	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Tillsonburg	32 00	32 00	1 00	3.8	2.5	0.3	10	4	5	10	5	10
Toronto	18 50	15 00	1 00	1.5	1.0	0.5	10	4	3	8	3	10
Waterdown	37 50	26 00	1 00	3.5	2.4	0.3	10	4	5	10	5	10
Waterloo	26 00	23 50	1 00	2.5	1.7	0.2	10	4	4	8	4	20
Welland	.....	14 50	1 00	1.8	1.2	0.15	25	4	3	6	3	25
West Hamilton	....Served by Dundas		1 00	2.8	1.8	0.2	10	4	4	8	4	10
Weston	30 00	30 00	1 00	3.3	2.2	0.3	10	4	4	8	4	10
Woodstock	26 00	23 00	1 00	2.5	1.7	0.2	10	4	4	8	4	25

hood of 600 miles of railway lines to date, for the most part covering territory west of Toronto and immediately north in the Markham and Uxbridge district.

A very marked enthusiasm has been shown by the municipalities interested and the climax of this enthusiasm was reached when a few days ago a deputation comprising some 2,000 representatives, sent by interested municipalities, assembled in Ottawa to place their claim before the Dominion government for the usual subsidy which amounts to $6,400 per mile. Premier Borden accorded the deputation a most careful hearing and there is little doubt but that the subsidy will be forthcoming in the comparatively near future. With many of the municipalities this would be the signal for authorizing the Commission to proceed with construction work.

In order to give the Commission all possible assistance as well as to forward their own interests the municipalities have formed themselves into a Provincial Hydro-radial Association. Officers have been appointed and a campaign of education has been started consisting of lectures and addresses in any town or village where sufficient interest can be aroused to get a fair-sized gathering collected. This scheme also has met with very gratifying success and if enthusiasm counts for anything the next five years should see south-western Ontario netted with a system of radial railways.

The value of radial transportation to the communities of Ontario cannot well be over estimated and it is questionable if any phase of the work of the Ontario Hydro-electric Commission will compare in actual value to the province at large with that of the development of hydro-radials. The power distribution scheme is in the main a work for the benefit of the cities and towns, and only in isolated cases have the rural populations reaped any direct advantage. The hydro-radial scheme is a countryman's proposition, however, and as such

will receive the support of every rural inhabitant in the province.

At present writing it looks as though the first section of hydro radials to be constructed and operated will be the one running north from Toronto through Markham township. This is one of the most favored agricultural districts in Ontario and being off the main line of any of the steam railway roads it has received less attention in the way of transportation than it deserves. It is believed that a system in this section can be made to pay from the very start.

Book of Wiring Rules

Another important feature of the Commission's work has been the compilation of a book of rules and regulations governing wiring. Early last year a tentative set of rules was prepared and submitted to engineering bodies, manufacturers, contractors, electrical workers and jobbers as well as fire underwriters. These bodies were requested to consider the proposed regulations and submit any criticisms to the Commission. After considerable time had been given to a study of the proposed rules and regulations criticisms were received and acted upon. The regulations for the most part follow closely along the lines of the National Electric Code which has been the adopted standard in Canadian and United States practice and of the Fire Underwriters Association. In the Hydro regulations the arrangement of the code has been considerably altered and many rules for the protection of life, not found in the National Code, have been added.

In addition to these rules and regulations a complete by-law was prepared in printed form for the use of the various municipalities where inspectors were to be appointed. This is saving the municipalities much confusion and loss of time and also provides for uniform installation and inspection. In this by-law the inspector's duties are well defined. A uniform scale of inspection fees has also been compiled and included. The law now requires that every municipality shall appoint a properly qualified inspector. The same inspector may attend to one or more municipalities depending on the amount of work entailed. Great care is taken in the selection of these men and the Ontario Hydro-electric Commission undertake to explain to the appointees the purpose of the work and the nature of the duties they are expected to perform.

Up to the present time a large number of appointments have been made and it is certain that a marked improvement in the quality of electrical work being done in all classes of buildings will be immediately noticeable.

Electric Testing

During the early months of 1913 a building designed to accommodate departments engaged in experimental work was completed in Toronto. This building is 110 x 70 ft. of three storeys and a basement, about one-third of which will be devoted to laboratory work and the remainder for storage of the large quantities of construction material, lamps, meters and other incidental supplies always carried in stock by the Commission. The laboratory contains a standard and meter department, an illuminating engineering department, a high tension and general testing department, and a lamp testing department.

The meter testing department has been organized and equipped with a view to proving the efficiency of all meter apparatus before it is installed by the different municipalities. The equipment of the new laboratory has been selected and installed with a view to making all the necessary tests. The equipment includes a first-class oscillograph put in in portable form so that it is now possible to make detailed investigations of matters affecting the current wave form at any point in the system. This department has from time to time done such work in this connection as has enabled the Commission's engineers to locate and take steps to remove a number of disturbing factors in the distribution system.

Considerable work has been done by the Commission in gathering data on all kinds of street lighting apparatus so as to be able to give reliable advice and information to the municipalities. During the past year information has been collected which enables the Commission to form accurate judgments both as to the artistic value of any particular kind of equipment and also the resultant illumination derived from it including such details as watts per linear and square foot, average illumination, maximum and minimum illumination and so on. Other points considered have been the distribution obtained by certain reflectors, the absorption of reflecting or diffusing media, mechanical strength, installation, and in general the suitability of any particular type of apparatus taking into consideration the price as well.

The high tension and general testing department is equipped with a 300 kv.a. 300,000 volt, 60-cycle transformer and a 50 kv.a. 37,500/75,000 volt, 25-cycle transformer. These transformers are used in determining the break-down voltage by flash-over or puncture of the various insulators used. Equipment has been installed also whereby tests may be carried out under artificial rain conditions. In this laboratory tests are carried out on the oil used in transformers and switches in the various sub-stations and by the municipalities. In general it may be said that electrical and mechanical tests of line apparatus may be made in practically any desired manner, special apparatus being manufactured in the laboratory workshops to meet any special conditions that may arise.

Lamp Testing Department

In the lamp testing department tests are conducted to determine the relative quality of the different makes of lamp and the quality of each from time to time during its life. On life tests all tungsten lamps are burned at the same efficiency and are measured at their rated voltages. After test, curves are plotted showing the performance of the different lamps. This data considered along with the cost of the lamp indicates which type is the most economical to use. Every known lamp, either carbon or tungsten, with a fair reputation has been subjected to exhaustive tests by the Commission.

Hydro on the Farm

The Ontario Commission have shown an entirely commendable attitude towards the application of electricity to farm use. The chairman of the board has been unceasing in his efforts to reach the rural population and has lost no opportunity to place himself in direct contact with the farmer so as to learn intimately all his needs at first hand and at the same time win his confidence in the sincerity of the commission's efforts and their ability to be of assistance. Mr. Beck has held himself available for lectures and demonstrations in any part of Ontario and it is gratifying to note that what has appeared more in the light of a theoretical possibility has been rendered a practical fact as the result of the businesslike tactics pursued by the Commission.

It would not be truthful to say that the use of electricity on the farms of south-western Ontario is general, but where conditions have been shown most favorable the results are very gratifying. At the present time some twelve townships are using electricity more or less on their farms. The fortunate farmers are those situated closest to the transmission lines connecting or serving the towns and villages along the way.

The cost of power to the farmer depends, of course, upon how many consumers there are per mile as it is necessary to make a service charge to each consumer to pay for the cost

of construction of the line. Where there are three consumers per mile this works out to about $3.00 per service per month. Five consumers per mile works out at about $2.00 per month and so on. In rural distribution work the customers have been divided into three clases (1) the consumer who wants light only; (2) the consumer who wants light and small motors up to (say) 5 h.p., and (3) the consumer who wants light, small motors and a larger outfit (say 20 h.p.) for such work as threshing and silo filling.

To the class A customers the Commission gives a single-phase service and in fact all customers with motors of 2 h.p. or less are served by single-phase. For class B a three-phase service is given. In the case of class C it is the custom to get a number of farmers, seven or eight, to form a syndicate and buy and use a twenty h.p. motor in common, the same syndicate to purchase a threshing machine, silo filler or any other similar equipment requiring so much power and only used two or three days each season. In this latter case the syndicate also purchase their own transformers.

In certain localities power is sold on a meter rate and in others on a flat rate. For example, in the township of Toronto there is a fixed charge of $24.00 and a flat rate of $36.00 per h.p. per year. Up to October 31, 1913, there were 11 miles of distribution line built in this township, 72 customers connected and 132 customers signed up but not yet connected up. In the township of West Oxford there is a fixed charge of $36.00 per annum with a flat rate of $30.00. In Waterloo the fixed service charge is $24.00 with a meter rate of 5c per kw.h. or a flat rate of $30.00 per h.p. year at the choice of the customer. In North Norwich township there is a fixed service charge of $24.00 with a meter rate of 4c or an alternative flat rate of $36.00 per h.p. year. In Grantham township the fixed charge is $24.00 and the meter rate 4½c with an optional flat rate of $22.00.

The farmer provides all poles, wire and other equipment on his own premises, the municipality paying the cost of the wire as far as the first pole on his property. The municipality also owns the meter where one is used. The cost of wiring varies from $1.25 per outlet for open work to $2.50 per outlet for concealed work. The Ontario Commission have got out standard plans and designs for the wiring of barns and farm houses with suitable locations for motors, water heaters, etc., and are in a position to recommend to the farmer a suitable layout for his house and farm buildings which will give him a maximum amount of service with a minimum outlay. At the same time the necessary precautions are always observed in the wiring of barns and houses on the farm in order that all fire risk may be eliminated.

The usual installation for a 250-acre farm (it is a fact that the scheme as yet is more practicable on farms of 250 acres and up) as recommended by the Commission is that a farmer install a complete lighting system in the house, barns, cow stable, etc., with two lights in the farm yard and one outside the gate on the road. For power purposes he is advised to permanently install a five h.p. motor in some suitable position in the barn so that he can drive a milking machine, grinder, turnip pulper and in many cases a pump all off the same shaft. In some cases it may be necessary to install a small motor for pumping or for running a cream separator and churn in the milk house.

Another installation strongly recommended by the Commission is a water heater in the residence or in the milk house. This consists of a twenty-gallon can surrounded with packing so that the heat will not escape and fitted with an electric heater. The heater is a 600 watt unit and though it only raises the temperature of the water slightly it can be kept on during the off-peak load of both night and day so that the farmer will always have on hand a goodly supply of hot water.

The Commission have performed a number of painstaking experiments of threshing grain and filling silos with motors of different sizes and are ready to supply the farmer with either a 20 h.p. motor or with smaller equipment even as low as a five h.p. outfit. The smaller equipment is not likely to find favor in Canada but a syndicate of four to eight farmers can supply enough power even for threshing.

Lighting the Roads

There has always been a demand for a certain amount of light along the rural roads and though it is not necessary to have as much illumination as in more thickly populated districts, lights are very convenient at such places as railway crossings, bridges, culverts, etc. In districts where cost is of primary importance it has been the custom to install one 100 watt tungsten outside the gate of each farmer who is being served with power. The light is placed on a cross arm and controlled by a switch near the front door of the farm house. In districts where more complete lighting is required installations of 100 watt lamps with radial reflectors have been installed about every 1,000 feet.

Procedure where power is required by any township is made as simple and easily understood as possible. A petition is required from the township desiring the power, and then the Commission's engineers investigate the conditions and lay out a distribution system from the nearest town in the vicinity or by installing pole type transforming stations along the 13,000 volt line, if there are any such in the township. Power is transmitted to and through the township at 2200 volts by a three-wire, three-phase system. The conductor is No. 6 hard drawn copper wire on a four-pin cross arm on poles 25 or 30 feet high. As the distribution grows in extent in any township the system is changed over to the 4,000 volt four-wire distribution system with a No. 6 copper clad steel neutral run along the top of the poles. In most cases each farmer has his own transformer, 2200/220-100 volts, except where two houses are very close to one another.

Fig. 34a—Street Lighting by Magnetites in Peterboro.

Fall Fairs

A feature of the educational campaign carried on by the Commission has been the demonstrations of hydro-electric applications to farm work at the different fall fairs. Demonstrators were on hand to operate and explain the various uses of the appliances and all farm machinery was shown in actual operation. These demonstrations have always been the center of interest and have been the means of giving the farmers some new and accurate ideas on power possibilities in their work.

Typical Municipal Distribution Systems

(Specially contributed)

Hamilton

The Hamilton Hydro-electric System receives its power from the Ontario Power Commission's sub-station at Dundas. The power is transmitted at 13,200 volts by two circuits on wooden poles. When the system is completed, this will be replaced by four circuits on steel towers. At present, it is received at two sub-stations, one a temporary shack in the west end of the city, and the other the permanent east end sub-station. Their capacities are 1,200 and 2,150 kilowatts respectively.

In the completed system, there will be three sub-stations; the first, a small switching and transformer station at the corner of Dundurn and Head streets, near the western city limits; the second, the central sub-station, on Hughson street; and the third, the east end sub-station at the corner of Trolley and Burlington Streets. See Fig. 35 for wiring diagram of the primary system.

At the west end sub-station the power will be received through four circuits at 13,200 volts from Dundas. From there, two 13,200 volt underground lines will feed the central sub-station, 6,000 feet away, while two overhead lines at the same voltage will supply the east end sub-station and the city pumps at the Beach, and another will run to the Hospital for the Insane. The hospital buys its power direct from the Ontario Commission, but it is switched at the city's sub-station. The transformers at this sub-station will be three 250 kw., 13,200/2,200 volts, supplying three-phase delta feeders on wooden poles for power purposes, commercial lighting and street lighting. The switches will be Westinghouse type, lever operated oil switches.

At the central sub-station, both the incoming and outgoing lines will be run underground. The switches at this sub-station will be Canadian General Electric Company's type oil switches, and the transformers are to be seven 750 kw. single-phase, 13,200/2,200 volt, for small power purposes, commercial lighting and street lighting, and one 500 kw. three-phase, 13,200/550 volt for power purposes within a radius of half a mile from the sub-station. These and all the other transformers are supplied by the Canadian Westinghouse Company.

The east end sub-station and the pumping house at the beach, will be arranged so that they can either be operated on separate lines or together on either of the two lines from the west end sub-station. The pumping house is equipped with two 500 kw. 2,200 volt synchronous motors, each connected to a centrifugal pump.

The east end sub-station is to have Westinghouse type switches and six 500 kw. 13,200/2,200 volt transformers for power purposes, commercial lighting, and street lighting in the eastern part of the city.

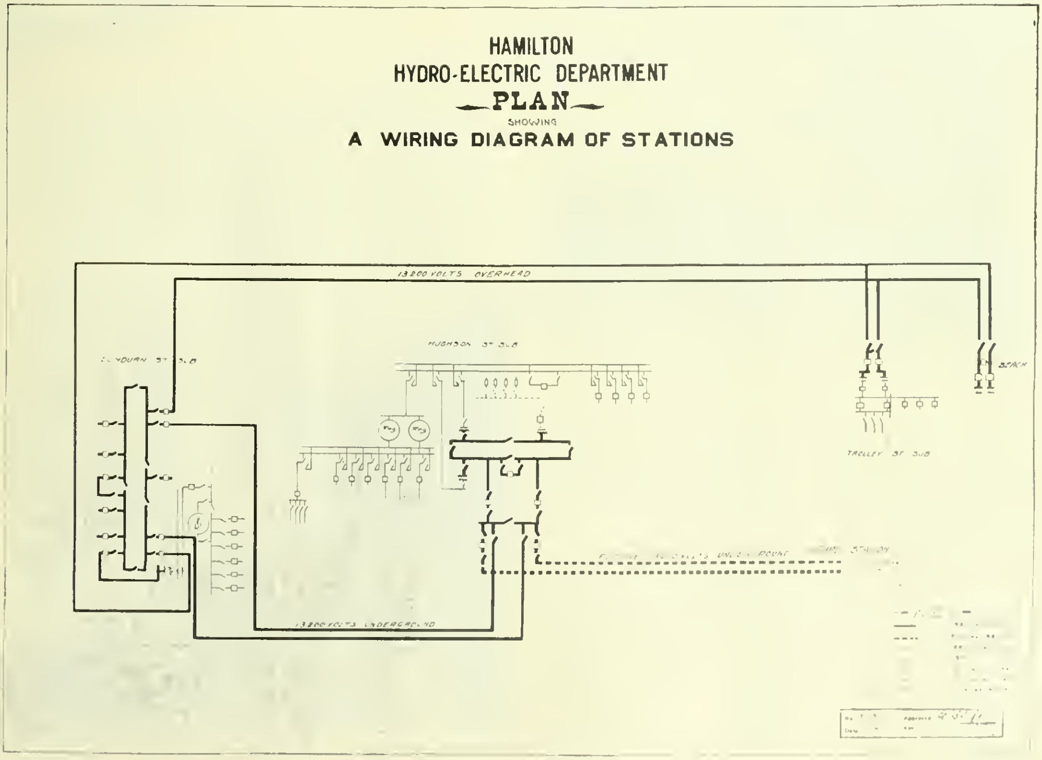


Fig. 35.—Wiring diagram of Hamilton's three substation

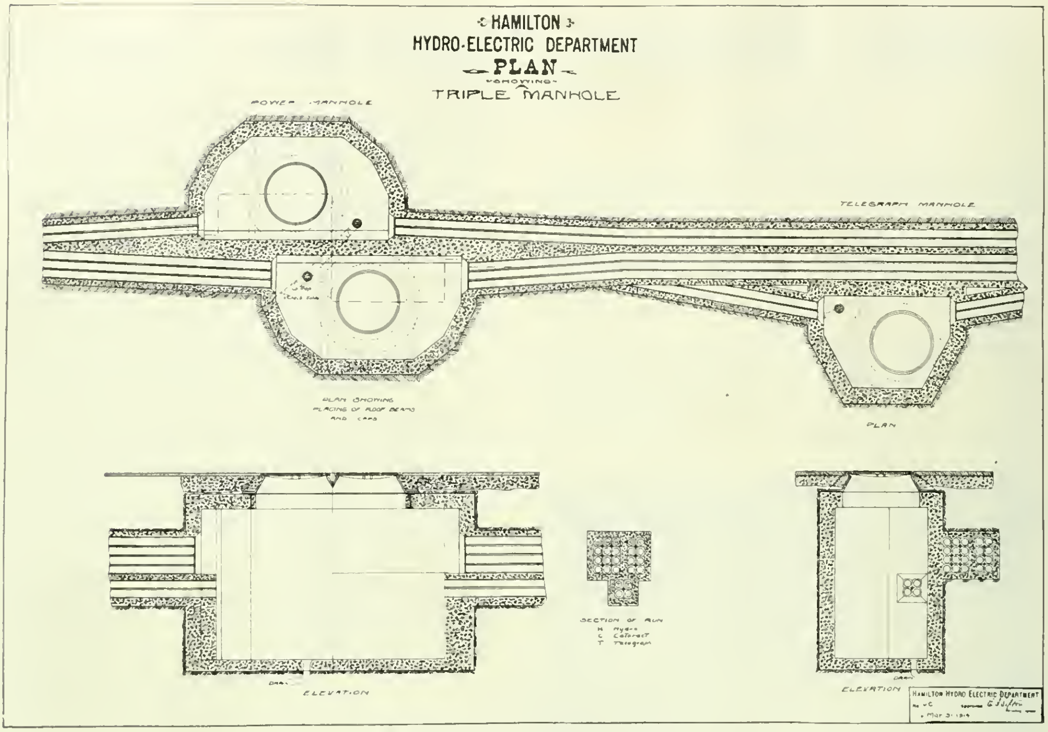


Fig. 36 Showing plan of triple manhole—Hamilton City.

Distribution

In the centre of the city, the distribution will be underground, about seven miles of conduits being laid in the main streets. The construction of these conduits is much the same as for the Toronto system, described in former numbers of the Electrical News. The Dominion Power, Light and Transmission Company and the telegraph companies will use the same trenches, but different manholes, see Fig. 36. Mr. G. M. Gest, contractor, of New York and Montreal, is constructing the conduits, and the cables are made and installed by the Standard Underground Cable Company of this city. Through these conduits, the current will be supplied from the central sub-station at 2,200 volt to transformers on overhead structures, in the courts in the centre of each block. Here it will be transformed to 110/220 volt for commercial lighting and to 220 volt, three-phase from the same bank of transformers for small power purposes. The secondary wires will be run in conduits or on brackets along the rear walls of the buildings to individual services, Fig. 37. This is one of the unique features of the Hamilton system. The 550 volt power will be distributed in the same way from 550 volt potheads on the transformer structures.

The overhead distribution will be divided into three districts. The 2,200 volt three-phase feeder lines in the east and west districts will be fed from their sub-stations direct, while in the central districts they will be supplied from the underground conduits. These lines run on wooden poles both ways across the city from 1,500 to 2,000 feet apart. In each district they will be tied in at the intersections, so a break will not put any part of the district out of commission. It will be arranged that if any sub-station breaks down, the others will supply its district through pole type disconnecting switches.

From transformers of 15 to 30 kw. capacity on these poles and on concrete poles at the edge of the underground district, Fig. 37, current is fed at 110/220 volt to secondary circuits on concrete poles, Fig. 39. Notice the wire running along the tops of these poles. This wire is of No. 6 galvanized mild steel, and is grounded at each pole and to the water pipe at each house lighting service. This is used in a fourfold capacity, first, as a lightning arrester; second, for me-

Fig. 37—Transformers installed on rear of building and on cement poles—Hamiltnn City.

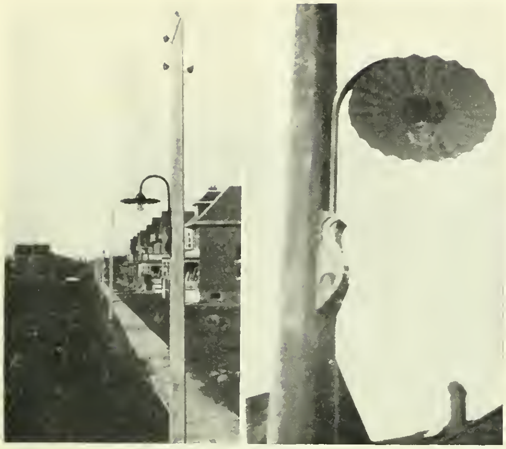


Fig. 38—Types of street lighting—Hamilton.

chanical strength; third, as neutral for the three-wire 110/220 volt house lighting secondary circuit; and fourth, as neutral for the three-wire 110/220 volt street lighting secondary circuit. This is another unique feature of the system.

Street Lighting

In the overhead districts the distribution for street lighting will be the same as for house lighting described above, the wires being strung on the same poles. A 250 watt tungsten lamp on the poles at street corners, seventeen feet above the ground will mark the intersections of the streets, while

Fig. 39—Showing 5-wire distribution system.

100 watt tungstens on all other poles 12½ feet above the ground and 100 feet apart will light the streets almost uniformly throughout their length, Fig. 38. Streets with car tracks will be lighted from both sides, other streets from one side only.

In the underground districts the street lighting feeders, like those for commercial lighting will be run through tile conduits set in concrete, 2,200—110/220 transformers in manholes will supply the secondary circuits, which will be run in fibre conduits. The lamp to be used in this district is a 1,000 candle-power, 500 watt, 110 volt nitrogen filled tungsten, mounted on a cast iron standard 14 ft. 6 in. high and set from 125 to 200 feet apart. The city parks are also to be lighted with ornamental standards, but these will be fed from a buried cable instead of from conduits.

History and Management

In the summer of 1911, the ratepayers of Hamilton voted $500,000 for the construction of the City's Hydro-electric System, Mr. E. I. Sifton, of London, Ontario, was engaged as engineer and business manager and under his capable direction, the system has been laid out. Mr. H. Barber was appointed as assistant to Mr. Sifton, in 1910, but resigned in 1912. In January of the present year an additional $335,000 was voted and a change made in the government of the department. At first the Board of Control had charge of the department, but now it is governed by a Commission elected by the citizens.

The Hamilton system is the only one that started to take on load as soon as it started construction, and it has shown a

Fig. 40—Toronto street lighting. Ornamental type; also combined lamp and trolley pole.

profit from the first. The growth of the system is shown in the chart, Fig. 28. The department is already lighting some streets and will light the rest this summer.

One of the interesting features of the accounting department is the system of unit costs. The average cost of erecting wooden and concrete poles, of stringing the wires, of connecting meters and services, etc., has been worked out. For this purpose all time and material is charged to some specific job and none to the often abused general work order. All overhead charges (capital cost, operation, maintenance, etc.) are divided proportionally into the following revenue-producing classes, house lighting, street lighting, power and water works. By this means equity of rates is assured.

Staff

The Hamilton Hydro-electric Commission consists of Messrs. W. Ellis (chairman), J. Allan (Mayor, ex-officio member) and T. J. Stewart, M.P. One commissioner will be

elected each year. Mr. Stewart's term of office is to expire at the end of this year.

E. I. Sifton, the chief engineer, is ably assisted by the following heads of departments,—H. O. Merriman, assistant engineer; J. A. Woodman, superintendent of construction; W. H. Childs, contract manager; Wm. Macmillen, accountant; S. Robins, purchasing agent.

Toronto

Very marked progress has been made by the Toronto Hydro-electric System. Though the first year's operations far exceeded the expectations of the local Commission the last year has shown no abatement in development both technically and commercially. The commercial progress is shown in the annual report just issued. This report gives the number of meters in use as 24,999 as compared with 13,858 a year ago, an increase of 80 per cent. during 1913. The number of street lanterns in use is 38,944 an increase of 15 per cent. The peak load in December, 1913, was 22,520 h.p. an increase of 31 per cent. over the peak load of the previous year which was also in December. The total income increased from $726,763 in 1912 to $1,159,339 in 1913, a gain of nearly 60 per cent.

The Toronto hydro-engineers have introduced a number

Fig. 41—Template for building manholes—Toronto.

of interesting features into their work. One of these is in connection with the underground construction work. A quite original idea has been introduced in connection with the construction of manholes and service boxes whereby these are now made up of concrete in preference to the regulation brick type. Special templates of metal and seasoned wood are used for constructing the two-way, three-way and four-way manholes (see figures). These templates or forms are placed in the excavation and filled in around with a standard mixture of concrete making a wall of cement approximately eight inches thick. The results have proved very satisfactory both as regards cost and in expediting the work and this method is now being successfully used on all their construction for man-holes and service boxes.

One of our illustrations gives a fair idea of the obstructions met with from time to time in underground installation work. This is a view taken in connection with the subway at Macpherson Avenue and Poplar Plains Road.

As mentioned elsewhere an extension to accommodate certain city equipment has been built on the terminal station at Strachan Avenue. This equipment is designed to take care of the requirements of the city in that particular section, and removes the necessity of a sub-station in that district.

Another of our views shows the transformers at the high level pumping station. In this station there are four 750 kw. three-phase transformers, six 200 kw. single-phase transformers, two 500 kw. rotary converters. In a temporary structure at Withrow Park the city has recently added a 500 kw. rotary converter and three 200 kw. single-phase trans-

Fig. 42 Completed manhole with template removed—Toronto.

formers to be used in connection with the supply of power to the civic car line on Danforth Avenue.

A number of small transforming stations have been erected in various parts of the city to take care of the increased power demands of large consumers in the respective localities. These small stations receive current at 13,000 volts and transform to 550.

In the matter of lighting Toronto has been one of the most progressive cities. The question of improved and efficient illumination on steam railway crossings has been under consideration for some time and several designs have been tried out. The type finally approved for general use, by the city authorities, consists of two enamelled reflectors supported side by side on a metal bracket arm standing out about three feet from the pole, Fig. 44.

These reflectors are of the elliptical type set at an angle to the crossing and mounted at an average height of 18 feet above the ground. The longer crossings have a double reflector fixture installed at each corner of the crossing just outside the gates. Each reflector contains one 250 watt tungsten which means a total of eight 250 watt lamps in all. A number of railway crossings are now lighted

Fig. 43—Transformers, high level station, Toronto.

up in this manner, including Royce Ave., Greenwood Ave., etc.

For the purpose of giving a better light on street railway intersections a special cluster fixture is suspended over the centre of the street intersection. The special cluster

Fig. 44—Lighting steam railway crossings—Toronto.

fixture is suspended by span wires attached either to poles or to buildings located diagonally across the street. Either five or three 100 watt tungsten lamps are used in each instance, according to the conditions and traffic requirements. These fixtures are placed about thirty feet above the ground level.

A 1,000 watt, 2,000 candle power nitrogen lamp is under test at the intersection of King and Yonge Streets and has been in service since the early part of this year.

In connection with the fire alarm system a special lamp is being installed for indicating the position of the boxes. A special fixture and lamp which is covered with a red cylinder has been adapted by the city to indicate these locations. These fixtures are fitted to the top of the present lanterns in a vertical position. It is estimated that a total

Fig. 45—Obstacles to underground work—Toronto.

of 350 of these will be required to cover the city and work on their installation is at present in progress. See Fig. 52.

Figs. 48, 49 and 50 are self explanatory and indicate the remarkable growth of the Toronto enterprise during the comparatively short space of time it has been operating. There are now 720 miles of streets covering approximately 35½ square miles being served.

Mimico

We have now about three hundred satisfied consumers who are using the Hydro for residence lighting and many more are contemplating taking out contracts. The rate of advance during the last few months leads us to believe that the growth during 1914 will double if not treble the growth of the system in 1913. We also have the district of Humber Bay under our supervision although outside our village limits. Our distribution in this district supplies light to about eighty residences the owners being perfectly satisfied with the service. Our latest undertaking is to install street lights from the Humber Bay West on Queen Street in the Town-

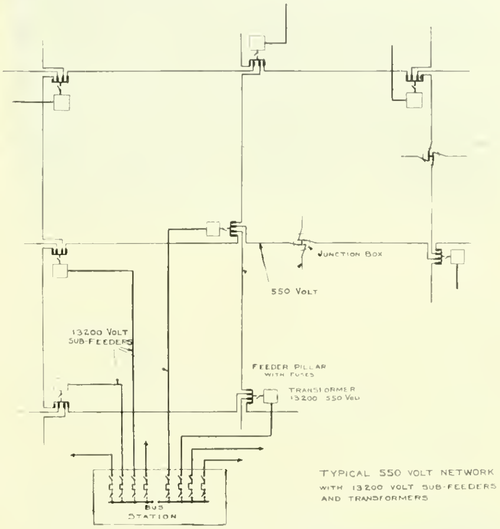


Fig. 46—Typical 550 volt power network—Toronto.

ship of Etobicoke for the distance of about one mile. Queen Street being the main highway through the market garden district west of Toronto, the importance of this line will be considerable.

The street lighting system within the village limits is now extended to all sections and is quite efficient and this speaks well for the advance that has been made as the village is very scattered and covers a large area. Our power consumers, i.e., the Victoria Industrial School and Carl Grobba, florist, are well satisfied with their service and the revenue from these accounts is an important item to our commission.

Woodstock

Hydro-electric Power was turned on November 30, 1910, and during December was used to a limited extent for lighting and to operate a few small motors. In January, 1911, several large motors were installed in the mills and factories of the city and a load of 600 h.p. was reached; this has slowly but steadily increased up to the amount given below.

The large industries of Woodstock being woodworking with a large amount of refuse, it has not been possible to build up as high a load as had they been in other lines of manufacture. However, the convenience and general satisfaction derived from electric motors has been such that nearly

every factory has one or more small motors in some part of the equipment, and it is a satisfactory point to note that following the first installation there is soon found to be just one or two other places where a motor would work in; so even the woodworking factories will eventually get in line.

The distribution system, as outlined in the November, 1910, number of the Electrical News has been adhered to with

Fig. 47 Conduit under concrete walks—Woodstock.

good results, outside of half a dozen or more small motors in the business part of the city, all the power is on 25-cycle, but the greater part of the business centre, as well as a considerable section of the central residential district, is still on 60-cycle. This is becoming more restricted every year for as the meters and transformers are moved in to supply the growing demand in the centre of the city, sections are changed to 25-cycle without discarding any apparatus. This policy the management propose to follow till the 60-cycle apparatus is worn out or obsolete, when the whole plant will be operated at 25 cycles and the present synchronous motor run for power-factor correction only.

One of the important changes brought about by hydro power is the much improved street lighting. The 90 arc lamps in use three years ago having given place to about 700 tungstens, over 400 of these being 6.6 amp. series lamps of 60 to 200 c.p. operated from two 15 kw. and one 20 kw. Canadian General Electric Company c.c. transformers. The balance are 60 and 100 watt multiple lamps in the centre of the city.

The main business street is lighted by 43 five-light standards manufactured by the Canada Foundry Company. These were installed in the summer of 1912 at a cost of $110 per pillar complete including one 15 kw. transformer and two time switches. Fibre conduit and lead covered cable was used entirely, about 4,000 ft. in all being required. The fibre conduit was laid in concrete under the sidewalks close to the curb, Fig. 47. This was done to avoid breaking the street pavement and also to clear the gas pipes which are laid along both sides of the street just under the gutter.

The sidewalks being flag stones, 10 to 12 ft. long by 3 to 5 ft. wide presented the greatest obstacle. This was overcome by raising the outer end about three feet with a chain block and derrick, see Fig. 47; and blocking in position with wood horses, made up for the occasion. Fifty to one hundred feet would be taken up, by which time the conduit would be laid for some distance, and the derrick gang would start replacing the flags. This had to be done very carefully in order to have the walk smooth on top. The men soon became expert, however, and left the walks in better shape than they were before; a very few stones broken in handling were replaced with cement.

The wiring is in two circuits, one half of the lights going off at midnight, the rest running all night. Two Campbell time switches attend to this part of the work and require very little attention.

The Waterworks Department has been operated by electric power since May, 1911, and the same has shown greatly increased efficiency. The pumping equipment being located in an adjoining room to the power plant, is under the charge of the same operator and is used to control the peak load and keep up a good load factor. It is interesting to note that in December the account for power was only 34 h.p. more than for the month of July. This was made possible by the careful operation of the waterworks motors and also in a few cases of extremely dark afternoons, starting one steam engine for an hour or more, and taking care of the extreme peak.

Below is given the connected load in December, 1910, and March, 1914:—

Commercial	Dec. 1910	March 1914
Incandescent lights	560 kw.	970 kw.
Street arc lights	90 kw	——
Commercial arc lights	85 kw.	10 kw.
Street incandescent lights ...	——	700 kw.
H.P. in motors	250 kw.	1100 kw.

Owing to the low rates made possible by the use of hydro power, residential lighting especially has become very popu-

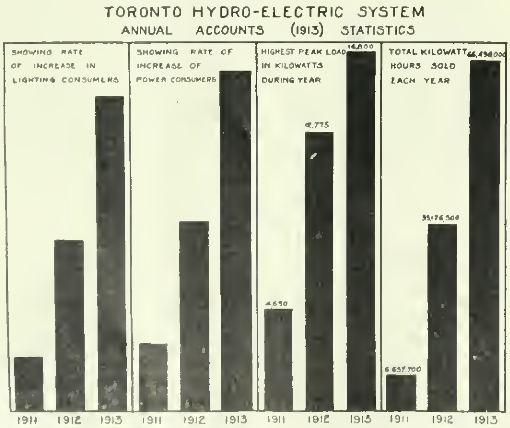


Fig. 48—Development of Toronto local system.

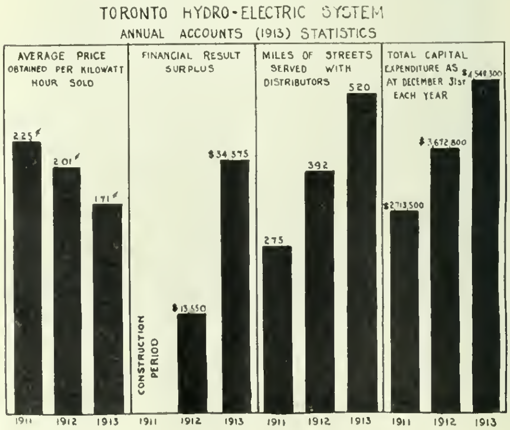


Fig. 49—Development of Toronto local system.

lar and is increasing rapidly, considerably over one hundred new customers being added since January 1st of the present year.

The Water and Light System is under the direction of the following Commissioners:—R. E. Butler, chairman, Col. John White, B. McNichol, J. G. McBeath, and Mayor Hobson; A. B. Lee is secretary-treasurer; J. G. Archibald, superintendent and electrical engineer; H. G. Hall, assistant.

Stratford

At the elections in January, 1910, the citizens passed a by-law creating a Light and Heat Commission consisting of 3 members, the Mayor, ex-officio, and elected J. J. Mason and Angus McDonald. The citizens have re-elected these two latter commissioners each time and they still hold office. At the election which created the commission the citizens turned down by an over-whelming majority a by-law to purchase the Stratford Gas Company's plant at $58,800, but the commissioners made arrangements with the Gas Company, for the operation of the plant for a period covering 10 years at a rental of $4,380 annually and on the completion of the 10 payments the plant was to become the property of the city. Later the citizens passed a by-law authorizing the issuing of bonds completing the purchase from the Gas Company for the sum of $43,800 in quarterly payments totalling $4,380 per year without interest.

In April, 1910, the city passed a by-law for $85,000 for general equipment and street lighting. This amount has been spent on construction, the work being under the supervision of Mr. C. J. Leacock and Superintendent R. H. Myers and possibly to these two men, more than to anyone else, we are indebted for the splendid equipment we have at present and at such a small cost. The street lighting system for several reasons was only a temporary arrangement and we have under consideration the submitting of a by-law for $22,000 to complete a street lighting system, which will be second to none for any city of our size in the province. In fact the by-law will be submitted to the City Council before this is in print and no doubt will be adopted by the citizens in the course of about 3 weeks. If this is done the equipment will

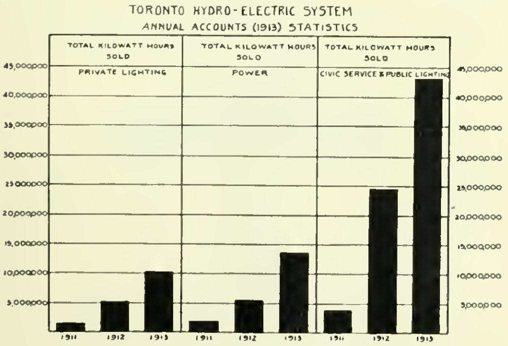


Fig. 50—Development of Toronto local system.

be completed before the 1st of August, when we expect to have a Stratford Old Boys' Re-Union.

Mr. J. J. Mason has been chairman of the local commission with the exception of last year, when Mr. Angus McDonald was chairman. The other member of the first commission was Ex-Mayor Dingman, and these members gave unstintingly of their time and talents to the working out to a successful issue of Stratford's venture of a municipal ownership of an electric light plant.

This civic department has had unqualified success. In the 4 years since the plant was taken over the price of electricity has been reduced 33 1-3 per cent. and in December last the commission made a further cut of 20 per cent. in residential lighting and about 10 per cent. in commercial lighting. When the plant was taken over from the Gas Company, there were 318 customers and at the end of 1913 we had 1,545 customers. The revenue in 1909, the last year of the old Gas

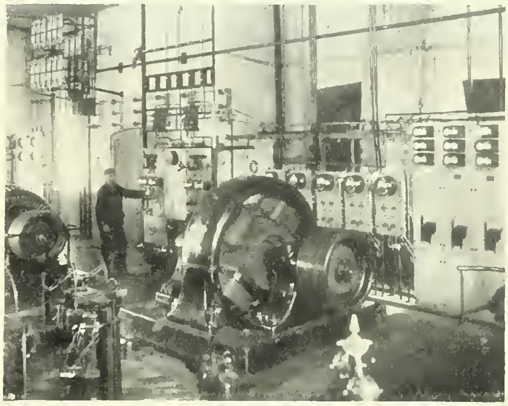


Fig. 51—Interior municipal station—Stratford.

Company, was $25,386. Last year, for 1913 the revenue was $55,914, while the actual surplus on the year's operation was over $10,000 net, after providing for interest and sinking fund on debentures and also the payment of $4,380 on purchase price to the Gas Company.

A branch line to Sebringville was built last year and in January last our load nearly reached the 1,000 h.p. There is no public question in this city stands so high in the estimation of its citizens as our Hydro-electric Power proposition.

Fig. 51 is a view of the interior of the Stratford Municipal sub-station. From right to left the first panel shown is a 160 ampere power panel; the next two are lighting panels 50 amperes each, and the next five are series tungsten street lighting panels; the lightning arresters for the above panels are shown overhead. The three panels following are direct current, and belong to the two direct current dynamos, one in the foreground and the other behind the synchronous motor. This equipment was taken over by the city from the Stratford Gas Co. The panel in the far corner belongs to the synchronous motor shown driving the second direct current dynamo. The four tanks shown against the rear wall are aluminium lightning arresters for the in-coming 13,200 volt line. The bank of switches shown near the ceiling over the synchronous motor panel belongs to the six 150 kv.a. transformers situated in a part of the room not shown on photograph.

Fig. 52—Toronto's Fire Alarm Signals.

The Dealer and Contractor

Underground Work in Kingston

The "Limestone City," Kingston, Ont., has followed the example of many of the other cities of Canada by having the central business area freed from all the objectionable and unsightly overhead electric wires, so that the principal parts of the city are now clear of everything but the ornamental standards, and the Civic Utilities Committee feel that Kingston has shown that it is quite as progressive as some of the more widely advertised municipalities.

The section of duct run from 4 to 18 in number. All runs were completely surrounded with a 3-in. concrete envelope. All ducts used were of the single square bore type. This was chosen on account of their laying together more firmly and taking less cement to bind together. The manholes have concrete base and tops. The sides were made of brick on account of the irregular shapes that had to be used, brick proving cheaper and more satisfactory.

Two or three brick service boxes (size 36 in. x 38 in.) were located between manholes. The bottoms of the services were left practically in line with bottom duct so that services would drain to manholes.

Typical underground work in Kingston.

For each manhole a connection to sewer was made and trapped in the usual manner. Two-inch iron pipes were run from these service boxes to buildings. This pipe was laid directly in ground after being painted with asphaltum.

At present no transformers are placed in manholes. The transformer poles are located at intervals on side streets adjacent to duct runs.

The conditions of construction encountered were somewhat serious; almost every manhole was sunk in the worst type of blue limestone, and to add to the difficulties of excavation caused by the presence of this limestone, was the serious inconvenience occasioned by the modern sewers and gas pipes and the old stone sewers constructed decades ago, which had to be removed or filled in. In the vicinity of these operations quite a few old coins were found, some dating back hundreds of years.

Specifications and plans for this contract were made in detail by the Hydro-electric Power Commission of Ontario. The Commission's inspector was present throughout the whole of the construction.

The contract was carried out by Dietrich, Limited, of Montreal, and the work is entirely to the satisfaction of the local committee as well as to the inspectors of the Hydro-electric Power Commission of Ontario. The following quotation from a Kingston paper is of interest.

"The engineer of the hydro-electric assured the deputation that the manner in which the conduits were being laid in the city was the best in the country. Local officials are satisfied that the work is being done better here than in any other place they visited."

High Potential Fuses

The Economy Fuse & Manufacturing Company of Canada, Limited, Montreal, have recently acquired the sole right of manufacturing in Canada, S & C Extra High Potential Fuses—Canadian Patent No. 140056, dated April 14th, 1912.

These fuses are made of a toughened glass tube which is filled with a non-inflammable liquid of extremely high dielectric strength, having none of the objectionable characteristics of oil. The liquid extinguishes the arc and interrupts the current flow, this action being still further accelerated by the contraction of a spiral spring simultaneously with the melting of the fuse element, thus introducing a very large gap. Since the dielectric strength of the liquid is about 250,000 volts per inch, this gap between the top ferrule and the top end of the submerged spring gives a factor of safety equivalent to several hundred thousand volts.

Numerous tests have been made, subjecting the fuse to severe conditions of short-circuit, and the results obtained were so remarkable that prominent engineers, both from this country and abroad, are said to have expressed themselves most favorably regarding the results of the tests and the future possibilities of the fuse.

During one investigation a total of 43 fuses were tested

on short-circuit and all opened the short-circuit successfully without causing the overload relays to trip the oil switches on the generators and transformers used in these tests.

Until within two years the most efficient high-voltage circuit interrupter for power work has been the oil-break switch controlled usually by some form of overload relay. On a system protected by apparatus of this type all the desired requisites are not obtained, owing to the frequently unreliable operation of overload relays, which in turn depend upon proper action of series transformers, and the heavy, slow-moving oil switch, which of necessity must be built of heavy parts to withstand severe short-circuits. These conditions render it almost impossible for a switch to operate with sufficient rapidity to prevent the entire system from becoming affected under short circuit conditions.

When the volume of current flowing is comparatively small, as characteristic of high voltage systems, circuit interruption by means of reliable fuses is claimed by many engineers to be preferable to the use of circuit breakers or oil switches. The type of fuse described above not only clears the circuit more effectively and rapidly but also has the decided advantage of a considerable saving in investment.

Electrose Arcover Line and Strain Insulators

Louis Steinberger, an inventor well known in the insulator art, has succeeded (after a vast amount of labor and costly experimenting, having had to overcome seemingly insurmountable difficulties) in producing on a commercial scale what are believed to be absolutely reliable suspension line and strain insulators for every voltage. These "Arcover" insulators are said to meet every requirement in a highly satisfactory degree. Their efficiency will doubtless at once receive due recognition from leading engineers and electrical manufacturing and constructing companies in all parts of the world.

These Arcover insulators are the only insulators with imbedded interlinked strain or suspension members that are made up of a single, integral and uniformly solid mass of insulating material without joints. Even though the insulating material should become totally destroyed, the line cannot possibly fall to the ground.

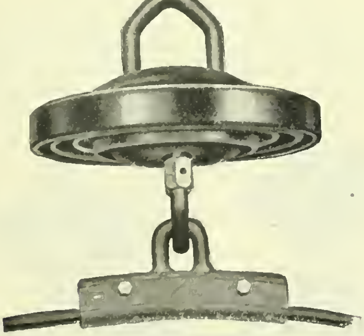


Fig. 1

The electrical and mechanical values of these insulators have been worked out to a degree of perfection never before attained in this class of devices and are in excess of ordinary requirements. Therefore they are especially well adapted for applications where unusually severe conditions prevail. These insulators possess a number of original and desirable features. Two or more units may be connected or disconnected in a fraction of a minute, no special tool being required; a plain wrench, a nail or even a piece of wire is all that is needed. No extra connecting member is required and there are no loose parts to be lost. The spacing of the units in their relation to each other has been worked out on scientific lines, to the best possible advantage.

The novel form of line clamp shown in connection with the Arcover insulators is also an invention of Mr. Steinberger, and possesses many admirable features; it has a smooth bore for gripping the wire or cable, thereby preventing crystallization and the possible breaking of the conductor at or near the clamp. It is designed so as to grip conductors of various diameters. It is light in weight, but sufficiently strong to break the conductor before slippage occurs. The metal parts employed in all these insulators are made of galvanized drop-forged steel.

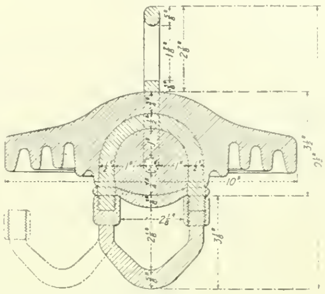


Fig. 2

In the table below are given the electrical and mechanical values of the 10-inch Arcover disk suspension and strain insulators, also of the 7.5-inch Arcover disk strain insulators:

	7.5-Inch Disk Strain Insulator	10-Inch Disk Strain and Suspension Insulator
Puncture value, in oil	120,000 volts	150,000 volts
Tested to dry arc value ...	85,000 volts	100,000 volts
Rain arc value	55,000 volts	55,000 volts
Line voltage	25,000 volts	25,000 volts
Mechanical value	20,000 lbs.	20,000 lbs.
Tested to	10,000 lbs.	10,000 lbs.

Arcover disk strain insulators are made in the following diameters: 5.5, 7.5, 10.5, 12.5 and 14.5 inches. Arcover disk strain and suspension insulators are made in the following diameters: 8, 10, 12, 14 and 16 inches. These insulators are made by the Electrose Manufacturing Company, 60 Washington Street, Brooklyn, N.Y., of which Mr. Steinberger is president.

New Companies

Stanworth Power Company, Limited, has been incorporated with head office Toronto; capital $250,000.

The Upton Electric Company, Limited, has been incorporated with head office Upton, Que.; capital $99,000.

The Bagot Electric Company has been incorporated with head office Saint Pie, Que.; capital $99,000.

The Canada Light & Power Company of Saint Jean Chrysostome, Que., has been incorporated with capital $140,000.

The Tillsonburg Electric Car Company, Limited, have been granted authority to increase their capital from $40,000 to $100,000.

The Skootamatta Power & Development Company, Limited, has been incorporated with head office Hamilton.

The Canadian Turbine Company, Limited, has been incorporated with capital $50,000, and head office Toronto.

Personal

Mr. **Robert Greer** has been appointed general electrician and foreman of the Weston electric light and waterworks system.

Mr. **Allan Pierson** has been appointed general superintendent of the Weston Electric Light & Waterworks Commission.

Mr. **H. M. Vanbuskirk** has been appointed manager of the Prince Edward Island Telephone Company, succeeding Mr. W. S. Grant.

Mr. **Arthur J. Cantin** has been appointed electricity inspector for the Inland Revenue Department of Canada for the district of Edmonton.

Mr. **F. R. Glover** who formerly had charge of the Vancouver and suburban system has been relieved of this post in order to allow him greater freedom in his duties as general executive assistant, an appointment he received in 1912.

Mr. **W. G. Murrin** has been promoted to the position of general superintendent of the B. C. Electric Railway Company, an appointment which somewhat alters his position with the company, his previous field being as mechanical superintendent to which there is now added the supervision of the company's Vancouver city and suburban street railway system.

Mr. **R. H. Sperling**, general manager of the British Columbia Electric Railway Company, Vancouver, has been offered a seat on the London board of his company, an offer which carries with it the appointment of Mr. Sperling to an important executive position as assistant to the chairman of the board, Mr. R. M. Horne Payne. It is understood that Mr. Sperling will accept the new post and that on his return from England, where he has gone to confer with the directors, the name of the company's new general manager will be announced.

Mr. Sperling joined the service of the B. C. Electric Railway Company in 1896 and in the following year was appointed the electrical expert in charge. He later became general superintendent of the company and on the appointment in 1905 of the then general manager, Mr. J. Buntzen, to a seat on the London board, Mr. Sperling was chosen as his successor.

The change in the personnel of the staff of this company on account of the promotion of the general manager to service in London, does not mean that there will be other changes in the staff in this province or that the policies of the company will be altered in any way. The organization and work of the company has been gradually built up as the result of years of practical experience, and it is stated that this organization and plan of work will be continued practically unchanged. This new post has been recently created because of the rapid development of the company's work, and the great increase of its investments in British Columbia. The offer of the position has been made to Mr. Sperling because the London board recognizes that he is fully equipped for this important field of work owing to his long residence in British Columbia, his intimate knowledge of the company's work as gained by practical experience during the period of the company's great development, and his detailed knowledge of the company's general policies.

Windsor Street Station, Montreal

In our April 1 issue we described the electrical features of the new C. P. R. Windsor station, Montreal. We failed, however, to note one of the most important items, namely, that the lamps supplied were the well known Northern Lights manufactured by the Northern Electric & Manufacturing Company.

Washing Machine Display

The accompanying photograph shows a display of "1900" electric washing machines recently made in the windows of the Toronto hydro-electric shop. The display consisted of an electric motor-driven washer and wringer also a motor

Washing Machine display in Hydro window.

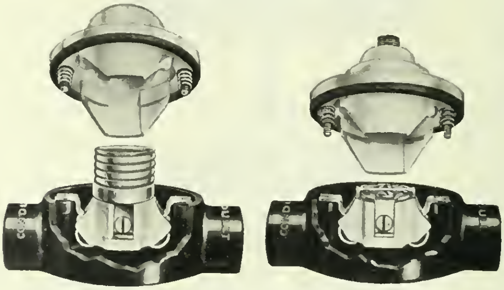
driven and electrically heated ironing machine. An actual demonstration of washing was given where clothes were washed, put through the wringer and then ironed. This display attracted an unusual amount of attention on the part of the passers-by.

Moonstone Glassware

Following critical tests on various types of glassware we understand the Toronto Hydro-electric Power Commission have decided to adopt Moonstone glass for all their street lighting work.

New Condulet Bodies With Elliptical Openings

The illustrations herewith represent type RJ elliptical condulet bodies so designed that elliptical conduletto fittings and elliptical covers fasten to them by means of two screws which are always accessible. These two screws secure both cap and base of the elliptical fitting to the con-



Two views of Type RJ, showing Elliptical Conduletto Rossette.

dulet body. A gasket is furnished with each fitting which makes the installation waterproof. Ample space is provided in the condulet body for the unobstructed passage of extra wires.

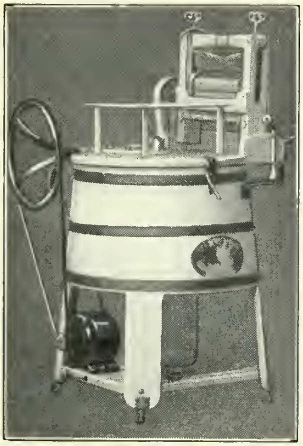
This equipment is being placed on the market by the Crouse-Hinds Company of Canada.

Hamilton Section C. E. A.

The Hamilton section of the Canadian Electrical Association at their monthly meeting held on March 26 heard a lecture on "The Mississippi Power Plant, Keokuk, Iowa." The article was written by Mr. Walter Goodenough and presented by Mr. L. W. Pratt, sales manager of the Hamilton Electric Light Company; the lecture was illustrated by a large number of lantern slides. At the same meeting Mr. S. Holland of the Canadian Westinghouse Company gave a practical demonstration of the use of the pulmotor in resuscitating persons subjected to electric shock. The musical part of the programme was prominent as usual.

Electric Washer De Luxe

The White Dove Company of Cobourg, Ont., are putting on the market an electric washing machine which is creating a considerable interest among central station men and dealers. The manufacturers claim that this machine has



been subjected to the most severe tests and has stood up in a way which gives them entire confidence in its operation. It derives its name from its color, being finished in white enamel and bronze and presenting a very neat appearance. The accompanying illustration shows one of the washing machines of this company.

Electric Vehicle Convention in Philadelphia

The Electric Vehicle Association of America will hold its fifth annual convention this year in Philadelphia during October, the exact date to be announced later.

242. **Electrical material.**—A large firm in Columbia, South America, inquires for electrical material.

Trade Notes

Chain Blocks—Bulletin B3 issued by the Herbert Morris Crane & Hoist Company, Limited, Toronto, describing the Morris travelling spur-gear chain block. Particular attention is drawn to the snug construction of these travelling lifting gears, the chain block being built right into the trolley so that no head room is wasted. Some interesting information is given and price lists are appended.

Electric Vehicles—The joint committee of the Electric Vehicle Association of America and the National Electric Light Association have distributed a little booklet entitled "Electrical Vehicle In Parcel Post Service for Economy and Reliability."

Fused Switches—A pamphlet issued by the Detroit Fuse & Manufacturing Company describing the Detroit iron-clad fused switches.

Welding and Cutting Plants—Booklet issued by the Waterhouse Welding Company, Boston, Mass.

The Hubbard Reference Book—Messrs. Hubbard & Company, of Pittsburgh, Pa., have just issued their 1914 reference book with which is combined a catalogue of Peirce brackets and other construction specialties of Hubbard manufacture. This book is especially remarkable for the number of very excellent illustrations it contains showing many examples of the latest and most improved practice in overhead line construction work. Another interesting feature is a list giving construction details of 131 different high tension lines, compiled from articles that have appeared in electrical journals the world over. This list is accompanied by seventy-five diagrams showing the tower construction used. The latter half of the book is given over to a catalogue of Peirce specialties covering their varied lines of wall brackets, pole brackets, secondary racks, knob fixtures, tungsten brackets and pole line brackets which they manufacture now for practically every voltage. We predict that this book will find a place in the reference library of electrical men from technical engineers to linemen.

Pole Reinforcement—Booklet issued by Messrs. Hubbard & Company, Pittsburgh, describing their methods of pole reinforcing by the Orr patent process. The Hubbard Company are successors to the Pittsburgh Reinforcing Company in the manufacture of this equipment.

Electric Control—Bulletin No. 242, issued by the Canadian General Electric Company, describing the Sprague electric control systems for newspaper and rotary magazine presses; well illustrated.

Panels and Cabinets—Bulletin 34, issued by the Canadian Krantz Electric & Manufacturing Company, Limited, describing their panels and cabinets. This bulletin is well illustrated and contains also price lists of the various types of equipment manufactured by this company.

Condulet Fittings—The Appleton Electric Company of Chicago have just issued a very complete catalogue illustrating and describing their useful line of unilets and conduit fittings.

Railway Signals—Bulletin 115C, issued by the General Railway Signal Company, Rochester, N.Y., describing their model 2A signal; bulletin 106A describing their improved lightning arrester model 1B; bulletin 130 describing their rail clips and conductor bars.

Port Arthur Has Good Year

The results of the operation of the electric and telephone departments of the city of Port Arthur, for the past year, have just been announced. In the electrical department the total revenue was $174,733. After deducting operating expenses the gross revenue was $107,864; with further deductions of fixed charges $37,556, and bad debts $1,200, the net gain for the year was $69,106. The number of consumers is 3,400. The domestic lighting rates are now 4c per 100 sq. ft. plus 2½c per kw.h., less 10 per cent. discount. The commercial lighting rates are 6c for the first 30 hours use of installed capacity and 2½c per kw.h. for all in excess, less 10 per cent. The total revenue of the telephone department was $46,097 and the net gain after all charges are deducted, $1,728. The number of subscribers is now 2,700. The domestic rate is $15.00 and the commercial rate $30.00 per annum. Mr. J. J. Hackney is Commissioner of Utilities.

Current News and Notes

Arnprior, Ont.

The town council has closed an agreement with the Galetta Power & Milling Company under which the latter agree to supply light at 75c per month per 60 candle-power lamp during 1914.

Barrie, Ont.

Permission has been granted the Toronto, Barrie & Orillia Railway Company to operate their cars on Sunday. The bonding privilege has been increased from $30,000 to $40,000 a mile and the time to complete the line has been extended to five years from the passing of the act.

Brigden, Ont.

A contract has been awarded to Harry Smith of Petrolea for the wiring and installation work in connection with Brigden's new street lighting system.

Calgary, Alta.

Recommendations have been made by the Calgary commissioners having in view the removal of all poles in the central section of the city. The Alberta government telephone department and the Calgary Power Company are asked to co-operate with the city in having all wires placed underground within a certain stated area.

The commissioners have recommended that the city railway system be given a reduction in their power rates from 1¾c to 1.6c per kw.h.

Chandler, Que.

The Parsons Pulp & Lumber Company will install at Chandler, Que., two 1,000 kw. turbo-generator sets and about twenty-five induction motors scattered through the different departments of their pulp mill. These motors will range in size from 15 to 150 kw. This equipment is being supplied by the Canadian General Electric Company.

Edmonton, Alta.

An order has been placed with the Siemens Company of Canada for 700 water meters of the vane type with frost protection.

A by-law has been submitted asking authority to expend $120,000 on electric light extensions.

Guelph, Ont.

An extension of time for the completion of certain branches of the Guelph Radial Railway system to five years from the passing of the act has been granted by the Railway Committee of the Ontario legislature.

Halifax, N.S.

The Siemens Company of Canada have received an order from the Acadia Coal Company, Nova Scotia, for two 380 h.p., three-phase, 2200 volt, 60-cycle, 146 r.p.m. induction motors of the slip-ring type provided with short circuiting and brush lifting device, together with liquid starters and cast iron mining pillars. These motors are to be used for driving air compressors.

Hamilton, Ont.

The Dominion Power & Transmission Company have let further contracts in connection with their auxiliary steam generating plants as follows:—Condensing outfit together with boiler feed pumps to the Canadian Westinghouse Company; two stacks to the Canadian Kellogg Company; boilers to the Edge Moor Iron Works, Edge Moor, Deleware.

The tenth annual report of the Canadian Westinghouse Company for the year ending December 31, 1913, is just to hand. The financial statement shows the total assets of the company to be $8,446,605. The profits for the past year were $1,002,618 which was distributed as follows:—Dividends at 9 per cent. $445,026; bank interest $28,700; reserve for insurance fund purposes $50,000; written off property and plant $250,000; carried forward to profit and loss account $228,891. The total profit and loss account now stands at $1,531,491. The capital stock of the company is $5,000,000. There are no bonds.

The plant of the Canadian Porcelain Company, Limited, at Hamilton, is now operating full time. Practically the entire output is high voltage porcelain of which the Hydro-electric Power Commission of Ontario are large users.

Montreal, Que.

The Siemens Company of Canada, Limited, have obtained a contract for two and four core submarine cable to be installed between Prince Edward Island and Nova Scotia, a total length of 28 miles. The two-core cable is for telephonic purposes and the four-core for telephonic and telegraphic purposes.

The Siemens Company of Canada have received an order for 5 sets of 12,000 volt switching apparatus including oil switches, panels, etc.; also for 4 sets of lighting arresters, each set to consist of 3 horn gaps, triple pole oil immersed damping resistance, special triple pole choke coil together with disconnecting switches. This order was received from the Canada Cement Company.

Preliminary plans for an extensive hydro-electric scheme are being drawn up by an English firm of engineers for the Lachine Rapids Power Company. This company was incorporated in December of last year. It is proposed to develop power on the north and south sides of Heron Island, in the centre of the Lachine Rapids. For several months engineers have been obtaining the requisite data for the scheme, which, it is said, will cost several million dollars. A director of the company states that sufficient capital has been guaranteed to ensure the plan being carried out, and that a ready market for the power can be obtained in Montreal.

J. D. Lachapelle & Company, Montreal, have obtained a contract for two complete electric plants, including generators, switchboards and search lights, for the Three Rivers and Longueuil ferry boats now being built at Levis, P.Q. Each of the plants will include a 12½ kw. generator of the C. & C. Electric & Manufacturing Company's make with Robb vertical engine. The generator is to be 120 volts compound wound. With the ferry for Three Rivers there will also be furnished a 14-inch Carlisle & Finch searchlight. A system of automatic control for the signal lights will be installed on both ferry boats. In both instances the installations are to be entirely done in galvanized iron conduit.

It was stated, in error, in our last issue that La Cour motor convertors had been sold by the Ferranti Electric Company to the Canada Cement Company and Messrs. Armstrong, Whitworth and Company. The sales were made to these companies by Messrs. Roper, Clarke and Company, Montreal, the Eastern agents for Messrs. Bruce Peebles.

Mr. James Bennett of Montreal, has been retained by the Shawinigan Water and Power Company to examine the company's distribution lines, transformers, entrances and other details affecting the condition of the company's distribution system to Three Rivers, as regards its compliance with the regulations of the fire underwriters.

Ottawa, Ont.

The Ottawa Municipal Electric Commission is contem-

plating making some substantial additions and extensions to their plant as the present equipment is taxed to the utmost to take care of the business offering.

Sometime during the coming summer the Ottawa Electric Railway Company will open a new steam auxiliary power plant on Middle Street, near the Chaudiere Falls. This plant will be equipped with a 4,000 h.p. steam turbine, manufactured by the Westinghouse Company, also three Babcock and Wilcox water tube, marine type boilers to which will be attached chain feed stokers. The equipment is now being installed.

Sir Henry Egan, director of the Ottawa and Hull Power Company, and Lady Egan, are spending a vacation in Hot Springs, Va.

Mr. Thomas Ahearn and Mr. James D. Fraser, president and secretary-treasurer, respectively, of the Ottawa Electric Railway, returned last week from a month's visit to the Bahama Islands, Havana and Florida.

Peterborough, Ont.

The private bills committee of the local legislature has recommended that the city of Peterborough be given power to take over the distribution plant of the Peterborough Light & Power Company without being required to include the generating plant owned by the Auburn Power Company which is situated within the city limits and is practically a part of the system.

Quebec, Que.

In connection with the Sherbrooke-Derby Road being constructed by the Department of Roads of the province of Quebec we understand that public tenders are not called but that private tenders are called by correspondence.

Rossland, B.C.

A new 10,000 h.p. generating unit together with transformers and auxiliary equipment has arrived at the power site of the West Kootenay Power & Light Company at Bonnington Falls.

Regina, Sask.

The Flett Springs Rural Telephone Company have awarded a contract to Mr. V. O'Brien, Regina, to construct their telephone line.

Renfrew, Ont.

The town council has requested the Hydro-electric Power Commission of Ontario to submit an estimate on the cost of installing a complete system of street lighting.

St. John, N.B.

Tenders are called by the St. John Electric Railway Company for the erection of a new car barn 58 ft. x 115 ft., to be of brick and steel construction.

Saskatoon, Sask.

The keeping of a municipal electric store has proved rather disastrous in Saskatoon during the past year as is shown by a deficit of $1,527. A private company has offered to purchase the equipment at face value and carry on the business in the same location.

Stratford, Ont.

It is reported that nitrogen filled tungsten lamps will be installed for improving the street lighting system. A by-law will be submitted to the ratepayers in the near future.

St. Catharines, Ont.

The city has taken over the local line of the Ontario Power Company and St. Catharines citizens are being served since April 1 by their local commission.

St. John, N.B.

The amendments asked to the St. John River Hydro-electric Company's bill were defeated in the committee of the local legislature.

St. Thomas, Ont.

The St. Thomas Electric Manufacturing Company, manufacturers of electrical appliances, instantaneous electrical water heaters, etc., have opened a factory at 18 Catherine St.

Negotiations are proceeding between the city of St. Thomas and the officials of the London & Lake Erie Railway & Transportation Company looking to the operation of the municipal system by the company for a term of years.

Toronto, Ont.

All the different hydro-radial unions which have represented certain sections of western Ontario have been merged into one union to be known as the Provincial Hydro-electric Railway Radial Union of Ontario. Mr. J. W. Lyon, Guelph, is president, and Ald. Hannigan, Guelph, secretary.

A small fire occurred in the car barns of the Toronto & York Radial Railway Company on their Lake Shore Road line. Two cars were destroyed and $5,000 damage done to the building.

In the Railway Committee of the local legislature a motion has been passed ordering the Toronto Street Railway Company to continue the operation of its cars on Queen Street East to Munro Park. The terms of payment and service are left to the Ontario Railway & Municipal Board. This is a half mile line which was originally outside the city limits and which the company has maintained it is not under any obligation to operate. During the last two years it has been operated as a stub line and an extra fare charged.

It is understood that the Bell Telephone Company will construct a new exchange in North Toronto to be completed in 1915.

The question of public ownership and operation of telephones was debated at some length in the local legislature. The decision reached was that at the present time the suggestion is not feasible.

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Capitalizing Improvidence

No act of recent years has started more discussion or created more intense opposition than the Workman's Compensation Act which has been introduced and is apparently about to be passed by the local Ontario legislature.

It will be remembered that some time ago Sir W. R. Meredith, Chief Justice of Canada, was appointed a one-man commission to prepare an act which would provide for the compensation of workmen for injuries contracted in the course of their employment.

The bill just introduced shows that an infinite amount of work has been done on the subject and that nearly every contingency has been considered. Provision is made for the appointment of a commission of three to have charge of the administration of the act.

That the bill has failed to win the approval of a very large percentage of the interested parties is only a proof that the subject is an exceedingly difficult one to handle. We understand that it is recognized both by the author of the bill and by the government that it is not likely to be workable in its present form. Wide powers are given the commission, however, and it is hoped that with this as a foundation something more workable and considerably more equitable can be evolved in the course of two or three years.

The bill appears to have shouldered an altogether too heavy load on the employer. He is made responsible for accidents over which he has no control whatever, and to an extent that may easily be the means of crippling many a business concern. Compensation payments as high as 55 per cent. of an employee's salary would be payable under certain conditions, which means that, as the salary limit is placed at $2,000, an employer may be made responsible for the yearly payment of $1,100 during the life of an incapacitated employee. Under such circumstances, it can readily be imagined that an accident or series of accidents out of the ordinary may be the means of ruining many an employer.

While there are many other points at which the bill is open to criticism, the basic weakness lies in the fact that the workman does not assume any part of the responsibility either for the accident which disables him or for the after payments. Thrift, one of the most important, if not the most important, characteristic of a good citizen, is not only not encouraged but is actually discouraged by requiring no part of the compensation fund to be contributed by the employee. The natural and certain tendency will be to make that class of workmen which is at present improvident, still more so; which is at present careless, still more so; which is at present inclined to the socialistic opinion that the world owes them a living, still more so. The bill in its present form capitalizes improvidence, carelessness and irresponsibility. While all will agree that a workman's compensation scheme, properly contributed to and properly controlled, is much to be desired, it seems very certain that the bill in its present form is quite unsatisfactory and unworkable.

Stand-by Steam Plants

The question of stand-by steam electric plants is occupying much attention at different points of Canada at the present time, and especially in sections of Ontario served by Niagara power. Apparently it is largely a matter of how much we value continuity of service and how much we are willing to pay for it. It is very doubtful, however, if the general public stands to reap any very great benefit from an expenditure of large sums of money on stand-by plants. True, it may be necessary to walk home once or twice a year or very occasionally to requisition the candle or coal oil lamp, but aside from a limited inconvenience it is not easy to see where the average user of electricity is financially interested. With the manufacturer and the storekeeper the case is different and, especially with the former, financial loss may be very considerable. However, trouble may happen only once a year or once in two years. For such a contingency the expenditure of hundreds of thousands of dollars which are lying worse than unproductive all the rest of the year seems a last resort.

Possibly the cry for stand-by plants has been a little over done. It certainly means an increase in rates for every class of customer served and it is very doubtful, indeed, if the carrying charges on such a plant would not much more than compensate for the losses sustained by the customers in any one year. In the advanced stage of transmission engineering as we have it to-day the chances of interruption are being gradually narrowed in by elimination, one after another, of the weakest points in design. Protective apparatus, more perfect insulators, duplication of line and all the other expedients would appear almost to make any further insurance unnecessary.

A noticeable feature of the stand-by plant as it exists in Canada is that it is found practically only under conditions of keen competition. In such cases a break in the service of either of the competing systems has been utilized by their opponents to get new business, and delays which in the ordinary way would have meant nothing more that a few minutes pleasant gossip among the temporarily unemployed have been magnified much beyond their actual significance. Under the lash of competition and the taunts of inferior service from opponents the expensive stand-by plant has been resorted to. We believe that every possible effort should be made to perfect the hydro-electric system in any particular locality and that only as a last resort and under very special

conditions is it likely to be found that an expensive stand-by plant is in the best financial interest of the majority of the consumers.

An article of considerable value on this subject was read at the regular monthly meeting of the Toronto section of the A.I.E.E. by Mr. C. G. Spencer, mechanical engineer of the Toronto Power Company. Mr. Spencer is one of those who take it for granted that a standby plant is a necessity under such conditions as exist in Toronto. His paper, however, is of unusual interest as it treats in considerable detail of the necessary characteristics of a stand-by steam plant as compared with a steam plant designed to operate continuously. Mr. Spencer points out that these two types of plant differ in many ways and to such an extent that a unit specially constructed for either purpose cannot be efficiently used for the other. This is rather in opposition to the argument usually advanced that a steam unit can be used advantageously both to take care of emergency conditions and at a certain time of the day to take care of the peak load. In Toronto, we understand, the stand-by is utilized only for the one purpose for which it was installed, namely, emergencies. Mr. Spencer's paper appears in part on other pages of this issue. The extracts quoted deal particularly with the general design and characteristics of any stand-by plant. The remainder of the paper dealt chiefly with a review of the improvements and extensions that have been made to the Toronto stand-by plant of the company with which Mr. Spencer is associated.

Conservation of Coal in Canada

Canada's dependence on the United States for its supply of anthracite coal is a point strikingly indicated in the report just issued by the Commission of Conservation, on the "Conservation of Coal in Canada." Practically all of the most populous portion of Canada lying between Montreal, Que., and Moose Jaw, Sask., relies solely on the United States for its supply of anthracite coal. Further, there are indications that the United States may, in the comparatively near future prohibit the export of anthracite, and, as the only anthracite deposits thus far discovered in Canada, are confined to the area near Banff, Alta., it is of great importance that suitable substitutes be found as soon as possible.

Such a situation makes it clear that Canada should carefully husband her coal resources and, so far as possible, check all wasteful methods of mining and handling coal. With this end in view, the report suggests greatly needed changes in the form of coal-mine leases, the provisions of which should be carefully enforced by a competent engineering authority. This would go far towards preventing the careless practices followed at present in many coal mines. In addition to this, it is urged that the government should carry on investigations with a view to determining the suitability of slack and low-grade coals for use in gas producers for generating power, and their adaptability for the manufacture of briquettes for domestic use. By utilizing these inferior products in this way, not only would there be less waste, but the value of the public coal lands would be considerably increased.

Again, it is pointed out that central power stations situated in the vicinity of many of the lignite fields of Western Canada, could develop electric power for transmission to neighbouring manufacturing centres. This would mean a great saving, especially in the case of lignites that will not stand shipping to any considerable distance.

The experience of Great Britain, the United States and other countries in the manufacture of coal briquettes is given in some detail, and the methods adapted to conditions in Canada are indicated.

Comparisons are made between the bee-hive ovens and the by-product ovens for the coking of coal and the economies effected by the latter over the former are clearly presented.

In addition, short descriptions are given of the principal coal mines in Canada, as well as of the by-product coke oven plant of the Algoma Steel Company at Sault Ste. Marie, Ont. The report is well illustrated by means of maps, diagrammatic sketches and half-tone engravings, and should prove of great value, not only to those directly engaged in coal mining, but to all who are interested in the economic welfare of the Dominion.

Shawinigan Plant Completed

The Shawinigan Water and Power Company have now completed the five units in No. 2 power house. The third unit was started on September 1st last, the fourth on April 25 of this year, and the fifth will be in operation on May 15th next. Each unit has a capacity of 18,000 horse-power, or a total of 90,000 h.p., which can be raised to 100,000 h.p. in case of emergency. As No. 1 power house has a capacity of 55,500 h.p., the entire plant has a total of 145,000 electrical h.p.

The No. 2 power station is in two divisions, each consisting of two units, with the third unit in the centre, which is considered as a spare. The width of the building is 115 feet, length 180 feet, and the height from the bottom of foundation to roof is 112 feet. It is built entirely of reinforced concrete, brick and steel. The walls inside are faced with pressed buff brick, and up from the floor to about 10 feet with glazed enamelled brick.

All hydraulic machinery is separated from the electrical machinery by a reinforced concrete wall 16 feet high. The main turbines are of twin spiral case type. The rating of the turbine is 18,500 horse power, with an effective head of 145 feet. Each turbine is provided with an automatic governor and governor engine and with a relief valve. Each turbine is directly coupled to a three-phase, 15,000 kw. generator, and each generator is connected directly to a three-phase, 15,000 kw. transformer, which raises the tension from 6,600 volts to 100,000 volts.

The transformers can be connected on the high tension side to two bus-bar systems. These bus-bar systems are provided with sectionalizing switches, so that each unit with its transformer can be connected directly to its 100,000 volt transmission line. Each transformer is installed in the power house, and located on the basement floor, 11 feet below the main floor, on the tail-race side. These transformers are about 23 feet by 9 feet with a height of about 18 feet.

In the development for the second plant the canal was enlarged at the end to a forebay close by the new bulkhead constructed at an angle of about 30 deg., with the old bulkhead and adjoining it. The bulkhead is built of reinforced concrete and steel and provision is made for five 14-foot penstocks and one four-foot penstock to the exciter. The width of the bulkhead at the bottom is 60 feet. The height from the rock to the operating floor is 40 feet, and the length of the structure 225 feet. Each unit is complete in itself and independent, straight through from the bulkhead, penstock, turbines, generator, transformer, transmission line and step down transformer at Montreal.

The penstocks which connect the bulkhead to the power house, located on the lower level, are 14 feet in diameter and about 600 feet long. Inside the power house, immediately in front of each water turbine and below the main floor, each penstock ends in two branches, forming the connections to the two cases of the double spiral turbines.

The thirty-seventh convention of the National Electric Light Association will be held in Philadelphia June 1-5, 1911.

International Conference on City Planning

During the last five years national conferences on city planning have been held annually in various cities of the United States, and have aroused such widespread interest that many American communities are now anxious to have the Conference held in their city and are willing to contribute the funds for that purpose. The city of Toronto, therefore, is to be congratulated on being the first place on this side of the International boundary to entertain the Conference, which this year will become international in scope and character. The financial difficulties have been overcome by a generous grant from the Dominion Government, which has appointed the Commission of Conservation to act as hosts. The Ontario Government and the city of Toronto are also contributing. The question of city planning is thus recognized to be of national, provincial and municipal concern, and Field-Marshal H. R. H. the Duke of Connaught, the Governor-General, has graciously consented to open the Conference and to give an address.

The substantial assistance given by the Dominion Government is evidence that the town-dweller, equally with the agriculturist, is receiving attention, and that no only the Federal capital, but all our Canadian cities are receiving from the Federal authorities such advice and assistance as the Congress will afford them. Invitations have been sent to all cities and towns in the Dominion, requesting them to send delegations to the Conference and it is hoped that many will take advantage of the opportunity. Money could be spent to no greater advantage than in giving some of our city councillors the opportunity to come into touch with experts in civic problems from all over the continent. The aldermen will carry home ideas that, put into practice, will save their townspeople millions of dollars, besides acquiring a new sense of the responsibilities of their office and higher ideals of civic administration.

The scope of the Conference may be gauged by a glance at some of the topics which will form the main themes of discussion. Among these may be cited: The Relative Importance of City Planning as Compared with all other Functions of City Government, by Andrew Wright Crawford, editor of the city-planning section of the "Public Ledger;" Provision for Future Rapid Transit, by J. V. Davies, consulting engineer for the Brooklyn Rapid Transit Company; Rapid Transit and the Auto Bus, by John A. McCollum, assistant engineer, Board of Estimate and Apportionment, New York City; Protecting Residential Districts, by Lawrence Veiller, secretary and director of the National Housing Association, New York City; Toronto's Water Front Development, by R. S. Gourlay, of the Toronto Harbour Board; A Consideration of the Principles and Procedure of a Canadian Town-Planning Act, a draft of which is now being prepared by a special committee apopinted by the Commission of Conservation; and Recreation Facilities in the City Plan, by Henry V. Hubbard, professor of landscape architecture in Harvard University.

Additional interesting features will be a tour of the city and harbour of Toronto, luncheon topics, and an open session for the discussion of subjects to be submitted by members of the Conference.

Hamilton Pumping Station

The high level pumping station on Ferguson Avenue, Hamilton, is now equipped with electrically driven turbine pumps. When hydro-electric power appeared on the scene it was decided to replace the old steam plant by electric units. This station supplies water to two separate levels, making it necessary to install two different sets of pumps and each set was duplicated in order to make it sure that at least one set would always be available.

The two low pumps are special No. IV. two stage Mather and Platt patent high turbine pumps, each capable of delivering one million Imperial gallons per 24 hours against a total head from all causes of 131 feet. These pumps are direct connected by flexible belt laced couplings to 40 kv.a. Canadian General Electric synchronous motors with direct connected exciters. On test at the factory, a pump efficiency of 79 per cent. was obtained which, we understand, constitutes a record for this size of pump.

The pumps for the higher level are two standard No. V. four stage Mather and Platt patent high lift turbine pumps, each capable of delivering one million Imperial gallons per 24 hours against a total head from all causes of 326 feet. These pumps were connected by flexible belt laced couplings to two 100 kv.a. Canadian General Electric synchronous motors with two direct connected exciters. They were guaranteed to have 70 per cent. efficiency but actually gave 72 per cent. on official test.

The switchboard also equipped by the C. G. E. Company, consists of five natural black slate panels of the central station type, equipped with horizontal edgewise instruments and K-3 oil switches, each of which is tripped automatically through an inverse time limit overload relay. One panel is provided for the control of each synchronous motor and the centre panel controls duplicate incoming lines. A voltmeter is mounted on a swinging bracket at the end of the board and is arranged to read bus voltage on all three phases.

The line panel contains one oil switch, for each of the two lines and a single set of meters consisting of:—3 ammeters; 1 polyphase indicating wattmeter; 1 polyphase curve drawing wattmeter; 1 polyphase watthour meter.

Each synchronous motor panel is equipped as follows:—1 polyphase indicating wattmeter; 1 power factor indicator; 1 field ammeter; 1 rheostat mechanism; 1 D. P. D. T. field switch connected so as to excite the motor field either from a direct connected exciter or from a common exciter bus; 1 overload relay; 1 automatic oil switch; 1 starting compensator; 2 current transformers.

Starting arrangements for the motors are worked out in an unusual but very convenient way. Standard compensators are mounted on the wall, back of the switchboard, and are connected by bell cranks and operating rods to operating handles on the front of the panels, this mechanism being almost identical with the standard remote control oil switch mechanism. Ample room has been allowed for the switchboard equipment.

The "Cedars" High Voltage Switchboard

The General Electric Company, Schenectady, have obtained the contract for the switchboard for the 100,000 h.p. hydro-electric development of the Cedars Rapids Manufacturing and Power Company. This development is situated on the St. Lawrence river, about 35 miles above Montreal. The present switchboard installation is to be for the control of nine 10,000 h.p. units. The plant consists of a power house and a step-up transformer house, which are constructed separately, the transformer house being about 800 feet from the power house. The power house as at present laid out will have, as stated above, nine 10,000 h.p. turbines, each connected to a vertical water wheel type generator having a capacity of 7,500 kw. at 6,600 volts. There will also be three 1,500 h.p. exciter turbines each connected to a 1,250 kv.a. vertical water wheel type generator. These exciter generators will operate at 2,300 volts and will supply three-phase energy for driving individual motor generator exciter sets for exciting the main generators. The direct current

generators of these motor generator sets will each be operated in connection with a Tirrill regulator.

In the transformer house will be located the step-up transformers and a double set of low tension bus bars. Each 7,500 kw. generator in the power house feeds through directly to these bus bars in the transformer house. On each of these generator circuits will be one oil switch in the power house and two oil switches in the transformer house, one for each low tension bus bar.

The switchboard installation is divided into three sections:—first, the main control board for the 10,000 h.p. units in the power house; second, a vertical switchboard, which controls the 2,300 volt exciter system in the power house; and third, a control board and instrument panels for the control of the transformer circuits in the transformer house. The power output of the development will be measured on these transformer instrument panels.

The control board for the main units in the power house consists of nine sections, each controlling one main unit. Every section is made up of two portions—a control desk and an instrument panel. The equipment of the latter consists of the instruments for measuring the power output of the unit and a signal device for receiving and delivering signals from and to the generator room. The following is the detailed equipment of these generator instrument panels: one watt hour meter, one indicating a.c. ammeter, one indicating a.c. volt meter, one indicating watt meter, one indicating power factor meter, one d.c. volt meter, and one d.c. ammeter, the two latter being for the 150 kw. exciter. On the control desk are situated the controllers for operating the oil switches on the generator circuits; also the controllers for operating the field switches and field rheostats for the main generators. The excitation for the main generators is obtained from individual 150 kw. motor-generator sets, which are driven by 225 h.p. induction motors, the latter receiving their power from a 2,300 volt, 60-cycle, 3-phase alternating current circuit. On the control desk are also situated the necessary controllers for the field rheostats of these motor generator sets. This main control board will be furnished with two synchroscopes mounted on a swinging bracket for synchronising the generators. The synchroscopes are so arranged that in case one should be out of order the other may be used for synchronising any of the generators.

The 2,300 volt switchboard is used for controlling the excitation system in the power house. This is a 2,300 volt, 60-cycle, 3-phase system, energy for which is supplied from the three 1,250 kv.a., 60-cycle, 3-phase water wheel driven generators. These latter supply the necessary power for driving the motor-generator sets used for exciting the main generators. This 2,300 volt power is also used for the various auxiliary circuits throughout the power house, such as the pump motors, etc.

The 2,300 volt switchboard is made up of the following panels: three 1,250 kv.a. generator panels; ten 225 h.p. induction motor panels; one 2 circuit feeder panel; two 1 circuit feeder panels; one transformer panel. On the 1,250 kv.a. generator panels are mounted the necessary instruments for measuring the power output of the generators, the controllers for the generator oil switches, governor engine motor controllers, field rheostat controllers, field switch controllers, and the signal devices for receiving and sending signals from and to the generator room. The 10-225 h.p. induction motor panels are for the control of the 225 h.p., 3-phase, 2,300 volt, 60-cycle induction motors, which drive the 150 kv.a. exciters.

The equipment of the induction motor panels is as under: one polyphase watt meter, controllers for oil switches, overload relays for the automatic control of the oil switches, and Tirrill regulators for the automatic control of the excitation voltage on the main units, these regulators being connected to the field rheostat of the 150 kw., d.c. exciter. The equipment of the two circuit feeder panel, which is for control of the power to the governor pump motors, is as follows: two polyphase watt meters, two oil switch controllers, and overload relays for the automatic control of the oil switches.

One of the three-phase 60-cycle single feeder circuit panels on the 2,300 volt board is for the control of a feeder circuit which feeds three 500 kv.a., single-phase, 2,300 volt, 220/110 volt transformers, these being used for supplying low volt energy for heating, lighting, and power throughout the plant. The other feeder circuit panel controls the feeder circuit which delivers 3-phase, 2300 volt energy for driving the blower outfits for supplying ventilation to the main generators. The equipment of these panels is: one polyphase watt meter, two oil switch controllers, and overload relays for the automatic control of the oil switches. The transformer panel in this 2,300 volt switchboard is for controlling a three-phase bank of transformers, made up of three 1,000 kv.a., 6600/2300 volt, single-phase transformers, which are to be connected on the high tension side to one 6,600 volt, 7,500 kw. generator circuit, stepping the voltage down to 2,300 volt, this transformer bank to be used as a spare capacity for the 2,300 volt excitation system in case of a shut down of one or more of the water wheel driven units. The equipment of the panel is as follows: the necessary instruments for measuring the power output of the transformer bank; controllers for oil switches on both the high tension and low tension sides of the bank; and the overload relay for automatic control of the low tension oil switches.

The control desk in the transformer house is to be arranged for the control of the necessary switch gear for four transformer banks, and will be divided into four sections, each being for the control of one bank. Corresponding to each section of the control desk will be a separate transformer instrument panel. The capacities of the transformer banks will be: two banks of 24,000 kv.a., each bank being made up of three 8,000 kv.a., single-phase, 60-cycle, 6600/110,-000 volt transformers, and two banks of 15,000 kv.a., made up of three 5,000 kv.a., 60-cycle, 6,600/66,000 volt transformers. The equipment of each section of the control desk will consist of the necessary controllers for the oil switches on the transformer circuits and the ammeter switches, and potential receptacles for the instruments which are situated on the transformer instrument panel. The equipment of each transformer instrument panel is: one indicating ammeter, one indicating volt meter, one indicating power factor meter, one indicating frequency meter, one indicating watt meter, one curve drawing volt meter, one curve drawing watt meter, one curve drawing power factor meter, one watt hour meter, and synchronising device for the above curve drawing instruments, also relays for the control of the automatic oil switches on the transformer circuits.

It is interesting to note that the oil switches on the 6,600 volt circuits are to be Type H 6, which are designed for a normal voltage of 15,000 volts, and the oil switches used on the 2,300 volt circuits are to be type K 12 which are designed for normal operating voltage of 7,500 volts.

The engineers are Mr. R. M. Wilson, of the Montreal Light, Heat and Power Company (electrical), and Mr. Julian C. Smith, of the Shawinigan Water and Power Company (hydraulic).

The Niagara & Welland Power Company have withdrawn their bill. A request was recently made for an extension of time for the completion of certain of their works, but a protest by the Hydro-electric Power Commission of Ontario which claims the right to develop all power on the Welland Canal and use it for the people of Ontario resulted in the measure being withdrawn entirely.

The Power of Water in B. C.

By R. F. Hayward, Gen. Man. Western Canada Power Company, Vancouver

Much has been written about the value of the water powers of Canada, and much more has been written about the value of the great waterways of the Dominion, but attention has not been drawn to the greatly enhanced value of water powers which can be developed at deep tidewater.

It is well known that the British Columbia Coast has thousands of miles of protected deep waterways, but nobody knows how many hundreds of thousands of horse-power can be developed along the shores of the navigable inlets.

At some comparatively recent geological period the whole of British Colhmbia was covered with ice. The channels of the main glaciers are now the inlets of the coast line, and all along these channels there were numerous branch glaciers, which joining the main glacier high above the bottom of its channel, have scooped out basins in the side valleys which are now filled with fresh water lakes, discharging into the inlets over abrupt falls of anywhere from 100 to 300 feet in height. The lakes vary in size from a few hundred yards to 40 miles long, and the drainage areas which supply them vary from a few square miles to 400 or 500 square miles.

Somewhat modified conditions are found along the Fraser River, and further inland on the Thompson and Columbia Rivers, but practically all the important water powers of British Columbia are close to navigable salt water or fresh water. The water powers of the Coast Range not only have the advantage of being close to navigable water, but neither the water which produces the power, nor the water of navigation ever freezes up.

The rainfall of the Coast Range of British Columbia varies from 50 to 200 inches per annum, and is dependent upon the conformation and proximity of the mountains to the coast. What the precipitation amounts to in the high mountain ranges which form the upper parts of the watersheds, nobody knows, but sufficient rainfall data has been secured during the past twenty years to show that the annual precipitation over the whole Coast Range of British Columbia varies but very little from year to year. At a point about 50 miles inland from the mouth of the Fraser River, rainfall records, taken over a period of 20 years, show that in one year only, that of the great flood of 1894, did the rainfall vary from the average more than 16 per cent. In this particular year it was thirty per cent. above the average, and the floods along the Fraser River were unprecedented.

Favorable Conditions

This even precipitation, in combination with the large storage available in the lakes, the snow fields, and the glaciers, makes the water powers of the Coast Range very reliable. The proximity of water powers to navigable waters which are open all the year round, means that there is little necessity for expensive long distance transmissions and that, if the water powers are properly selected and developed, there is very little excuse for large auxiliary steam plants, which other less favourable conditions have made necessary throughout California.

These almost unlimited powers, with their constant supply of water which never freezes up, and their proximity to navigable waters which are open all the year round, are a source of enormous value to British Columbia, for, quite apart from the large cities, for whose supply ample power is already provided, these conditions give splendid opportunities for the establishment of all kinds of industries which require cheap transportation and cheap power in large quantities.

Industries for the manufacture of cement, nitrates and other chemical products, carbide, aluminium, wood pulp and paper, can generate their power at the back door of the factory, can bring their raw materials to their mill, by water, and can load their finished products at their front door on to ships that can sail to any part of the world, any day in the year.

Smelters can find locations at tidewater, where their ore, their power, their flux and their fuel are all close at hand; the conditions for the electric smelting of iron are ideal; and the time will come when the British Columbia Coast, from Vancouver to Prince Rupert, will be dotted with numbers of industrial towns such as those which have recently been established at the Powell River Pulp Mills and the Granby Smelter, from which their products will be shipped to all parts of the world.

The Government of British Columbia has wisely enacted laws which will prevent these valuable water powers from getting into the hands of speculators, and will thus preserve the use of the power for the best possible purposes. The Water Act was materially modified in the last session of the Legislature, and as it now stands it is probably as good an act, both for the protection of the interests of the Province and the bona-fide investor, as exists in any of the cities of the North American Continent.

Government Investigations

The Provincial Government has taken in hand the systematic investigation of the water powers of the province, and while the past two years have been chiefly taken up with organization, a large amount of useful work has already been accomplished, and in the course of years an individual or company who needs power for a bona-fide business will be able to secure all the preliminary information necessary for taking out a water record for the development of a power.

Those who have had to examine and develop new water powers in British Columbia, and know the great cost of investigating a watershed so as to get any reliable data upon which to base a development, will appreciate the value of the work which the provincial government is undertaking throughout the province, and in which the Dominion Government is co-operating within the Railway Belt.

While only an infinitesimal amount of the available water power in British Columbia has as yet been developed, the present requirements of the population are pretty well provided for, for the next few years.

The principal developments have been so fully described in the various technical journals, that it is only necessary to mention them by name here, they are:—

The West Kootenay Company's plant at Bonnington Falls.

The Vancouver Power Company's Lake Buntzen Plant.

The Vancouver Power Company's Jordan River Plant.

The Western Canada Power Company's Stave Lake Plant.

These were built for the supply of power to mines, railways, cities and general industrial districts. For purely industrial work, there is the large pulp mill of the Powell River Wood, Pulp & Paper Company about 75 miles north of Vancouver, and the Granby Smelting Company on Observatory Inlet about 100 miles north of Prince Rupert; also the hydro-electric plant recently established on Vancouver Island by the Dunsmuir Collieries, Limited.

Under construction there are plants for the supply of the City of Kamloops and the City of Prince Rupert, and various other developments are shortly to be undertaken, among which will be the hydro-electric plant for the supply of the power for operating trains through the tunnel which the C. P. R. are building under Rogers Pass.

Tenders are called for the completion of the power house building in Swift Current.

Hydro-Electric Power, St. Jerome

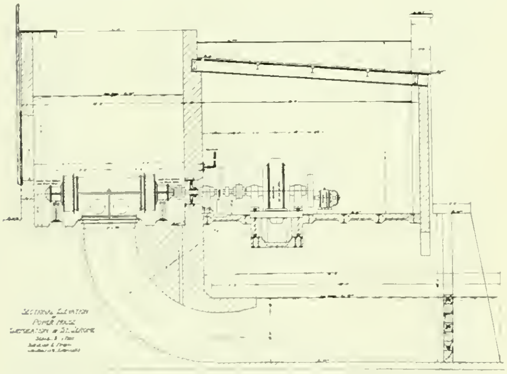
Progressive development of hydro-electric machinery has attracted not only capitalists, for good investment of superfluous capital, but also municipalities have commenced to build power plants of smaller capacities for accommodation of their citizens.

One of these municipal plants has recently been finished by the Canadian Allis-Chalmers, Limited, for the town of St. Jerome, P.Q., under the supervision of Messrs. Surveyor & Frigon, C.E., Montreal. The plant is situated on the North River, which carries its water from the Laurentian Mountains as a tributary to St. Lawrence River.

As low and high water conditions of this river are not unusually severe, the building of dam and spill ways, etc., did not demand extra precautions in the general design and construction.

The drop in the river at the point which was found best suited for the installation of the plant, is so low, however, that most careful methods in the design of flume, forebay and tail race had to be employed to obtain maximum output and efficiency of the generating station. The maximum head obtainable at the site varies from 18 to 21 feet, and as the ultimate capacity of the plant was settled at approximately 450 kw., the engineers decided on three units each at a maximum output of 150 kw. under the lowest conditions of head, namely 18 feet.

In order to obtain the above given head it was found necessary to build a small dam across the river, approximately 350 feet above the site of the power house. From there, the water is diverted into the wheel pits by means of a closed flume or pipe line. This pipe line is of reinforced concrete. It is 8½ feet in diameter with walls approximately 6 inches in thickness. The pipe line is set on solid concrete piers, so as to prevent settling and cracking. Where it enters the forebay (surge tank) it tapers out so as to allow the fast flowing water to decrease its velocity gradually until the water is received by the runners.



Section St. Jerome hydro-electric plant.

Dam

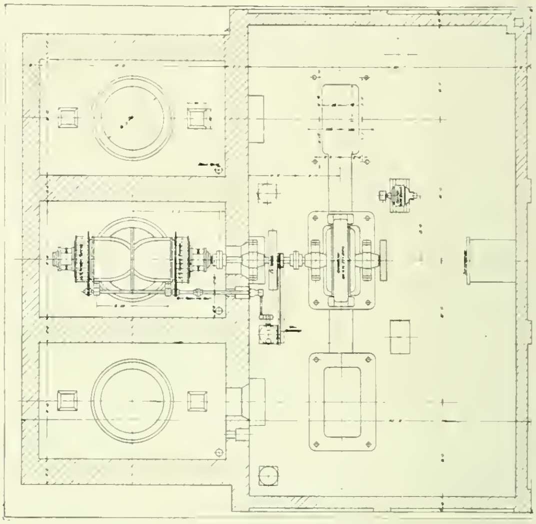
The dam work is of simple construction, of concrete, and designed partly as a spillway and partly as sluice dam with stop logs. At the intake to pipe line, a conical thimble of steel plate construction is placed behind the head gate. The head gate itself is of wood construction, and provided with hoisting apparatus for regulation. A steel rack is also provided to keep foreign floating material and rocks out of the conduit.

The surge tank is constructed of reinforced concrete in semi-circular shape, and its lower end forms a continuation of the wheel pit walls.

Three wheel pits are provided for, and the turbines are erected in two of these pits, the third being closed at present. These pits are provided with head gates and hoisting gears, so as to enable the operator to empty the pits at short notice. Drain valves and other auxiliaries are also provided. The draft tubes are concrete.

Turbines

The turbines are of the twin open flume type, designed to have a maximum output of 270 h.p. at 277 r.p.m., and operating under 20 feet head. Each turbine is controlled by swivel gates which in turn are connected to two regulating rings by means of steel links. The regulating rings are operated by means of one rigid gate which is directly connected to the hydraulic oil pressure governor situated in the generator room. The unit as a whole is designed to be easily adjusted for lining, the shaft being separated just inside the wall plate at the front end.



Plan of St. Jerome municipal power plant.

All inside bearings are of adjustable lignum vitae construction, and besides being bolted to the top plates are rigidly supported upon the foundation floor. The runners are made of cast iron with buckets of steel plate, cast and welded into it. The runners are guaranteed for 80 per cent. at full gate and 82 per cent. at 3/4 gate opening. The outboard bearing placed inside the generator room is designed as marine type thrust bearing, and is set upon a heavy cast iron pedestal. The wall plate being of cast iron is furnished with a stuffing box with bronze glands and neck rings.

A heavy flywheel is set upon the distance shaft to assist the governor in proper regulation. The governor is of the oil pressure type, and of self-contained design. It is capable of handling the gate apparatus from full open to closed position within 1½ seconds. A powerful hand control is further provided with the governor.

Electrical Equipment

The electrical equipment consists of two 150 kw., three-phase, 60 cycle, 277 r.p.m., 6600 volt, a.c. generators, arranged for direct connection to the turbines. The exciters are two 10 kw. type K units, 120 volts, 1150 r.p.m., arranged for belt connection. The four panel switchboard of blue Ver-

mont marble includes two panels for the control of the two generators, one for the control of the 2200 volt feeders, and street lighting feeders. There is also two 22 kw. constant current regulating transformers for the street lighting system; these are installed at St. Jerome. The distributing transformers consist of 25 oil-filled, self-cooled units, 2200 volt primary 110/220 volt secondary for house lighting and three oil-filled self-cooled units, 2200 volt primary to 550 volt secondary for power.

The sub-station at St. Jerome also contains three 100 kw., oil-filled, self-cooled, step-down transformers for reducing the transmitting voltage of 6600 to the distributing voltage of 2200. All 2200 volt distributing lines are double braided.

The length of the high-tension transmission line is 3 7/10 miles. Cedar poles thirty feet long are used outside the town limits and 35 to 40 feet long inside the limits. The circuit consists of three No. 6 B. & S. hard drawn, bare copper wires from the power house to the town limits, and No. 6 B. & S triple braid, weatherproof wire from the town limits to the sub-station.

The distributing circuits are controlled by circuit breakers of the automatic type located in the sub-station at St. Jerome.

The city street lights consist of 175 100-watt tungstens, four amperes, and fifty 250-watt tungstens, four amperes, controlled by constant current regulators. A telephone line is also built between the sub-station and the power house.

Stand-by Steam Stations

By Mr. C. G. Spencer

The object of a standby steam station at the end of an overhead transmission system is to provide a source of power immediately available in the event of an interruption in the transmission lines. An interruption often occurs with no warning, the abrupt failure of power being the first intimation of trouble. The reserve steam plant to be of maximum value in such a service must be designed to respond quickly to calls for power up to the limit of its installed capacity and to be able to carry the system load through a prolonged period depending on the ratio of installed capacity to total load, character of load curve and time of interruption, that is, whether on or off peaks.

An interest in this subject has been aroused in Toronto by occasional interruptions in the past necessitating recourse to candles, travel on foot and by a very active press. Niagara generated energy in reaching Toronto passes through a region at the easterly end of Lake Ontario which rivals the Tropics in atmospheric electrical disturbances, beginning in March and continuing for six months.

Sleet storms and high winds contribute to the operating man's interest in life for the remainder of the year. A catastrophe such as befell the lake boats last fall impresses us with the destructive force of the winds in the lake districts. For assured continuity a standby plant is required in Toronto for twelve months in the year.

This type of service imposes conditions that to be met successfully requires a plant differing radically from the central steam station usually met with. The first requisite and the one that must be uppermost in the mind of an engineer designing a plant for this service, is quick response to calls for power. The second and equally important requirement is ability to deliver power for an extended period. The third consideration is economic and one that the designing engineer cannot get away from, viz., initial investment, plant efficiency and operating cost.

This paper treats primarily with Toronto conditions.

*Mechanical Engineer, Toronto Power Company.

In discussing standby plants for Toronto the use of gas engines doubtless occurs to some present. A gas engine plant even in localities where natural gas is available, costs more for initial investment per kw. than a steam plant with turbines. With a producer plant added the cost is roughly two to one as compared with a steam plant. The ability to respond quickly from rest is not inherent in the gas engine. The question of using gas under steam boilers is treated more fully later on in this paper.

The choice of apparatus for this service admits of but little argument. The steam turbine from the smallest to the largest capacities costs less per kw. than the reciprocating engine. It might be argued that in a standby plant where efficiency is not of paramount importance that reciprocating engines running non-condensing would work out to advantage in the initial investment. This plan eliminates the cost of condenser tunnels and condensing apparatus. The extra boiler capacity required, together with the larger boiler and engine houses, however, makes this layout more expensive than turbines with condensers. The turbine can be put in service in much less time than a reciprocating engine; requires a smaller force per kw. to operate; occupies less space per kw.; requires simpler and less expensive foundations; costs less for operating supplies, such as oil, water, packing, etc., and the exhaust is not contaminated with cylinder oil. To sum up the comparison for this service the turbine is superior to the reciprocating engine in smaller initial investment, ability to respond quickly and reduced costs of operating labor and supplies.

Large Machines Best

In the selection of the number and size of units there is a big advantage in favor of the large machines. A standby plant would be manned by a small force, to minimize costs, which requires that turbines be put in service one at a time. It is very desirable to have the machines large to save delay in starting several small units. A large machine costs considerably less to install with auxiliaries and piping than two or more of the smaller machines of the same total capacity. For assured service it is a conservative policy to have sufficient installed capacity so that the station load can be carried with the largest machine out for repairs. Some standby plants are laid down, however, with but one large unit. A repair on this unit puts the entire plant out of commission. This question must be studied for each individual case, there being no general rule to follow.

The selection of the general type of condensing apparatus for Toronto conditions is simple. Condensers can be divided into two classes, surface and mixing. In the former the exhaust steam is condensed by coming in contact with metal surfaces cooled by injection water, steam not mixing with the injection water. In the latter type steam is condensed by mixing with injection water. As Lake Ontario is suitable for boiler feed and mixing condensers have been perfected to give as good a vacuum as surface condensers, there are no operating reasons for installing surface condensers for a standby plant in Toronto. The first cost of a surface condenser installation is roughly $3 per kw. greater than that of a mixing condenser installation for the same conditions. The condenser to be installed would, for these reasons, be of the mixing type.

Mixing condensers are still further divided between the low type and elevated type. In the former the injection water is drawn in by the vacuum but must be pumped out against atmospheric pressure less any slight draft tube effect in the discharge pipe. In the latter type, generally termed the barometric condenser, the water is drawn in by the vacuum and flows out by barometric pressure, the only work required by the pump being in overcoming the friction of flow. The elevated jet requires a longer exhaust pipe with a resultant drop in pressure and greater liability for

leaks. The low jet is more compact and requires no structural steel supports. In a high jet it is necessary to provide for the removal of condensation from the horizontal exhaust pipe. This is done by means of an entrainor in which the high velocity exhaust steam picks up the water and carries it to the condenser head with resultant pressure drop or by means of a pump which adds to the complexity of the plant. It is a safe statement that for large units the low jet is to be preferred.

As the capacity of a turbine plant is so dependent on its being able to run condensing at all times the problem of adequate condensing water must be given very careful study. It is assumed in this discussion that a plant in Toronto would be located on the lake shore. Once the condensers are purchased the guaranteed terminal difference can be obtained from the builders. Having this, together with the builder's water rate for the turbine at maximum load and the highest temperature of injection water during the summer months, the cubic feet per second of water can be obtained. The area of the intake tunnel should be ample enough to give low velocity to the flow. With the severe winters of this region, the lake end should be well below the extreme low water mark. This insures a supply of water from under the ice in winter and lessens the accumulation of floating matter on the racks at all times. As a further protection against frost, it is advisable to extend the tunnel into the turbine room at the same grade as at the lake end. The overflow tunnel should be designed for low velocity of flow and the condenser discharge pipes be sealed to give the maximum draft tube effect in the condensers.

Power for Condensers

The choice of motive power for the condenser auxiliaries lies between steam and electricity. Modern practice tends more and more towards motor driven auxiliaries. The motors, highly efficient in themselves, are supplied with energy efficiently generated in the main units. Bleeder type turbines allow low pressure steam to be drawn from the shell after it has passed through the high pressure blades. A thermostatically controlled valve regulates the flow of this steam to maintain constant feed water temperature with no heat loss. It is inpracticable to design a plant having steam turbine or engine driven auxiliaries exhausting into a feed water heater and to strike such a thermal balance that at times steam in large quantities does not go to atmosphere. Motor drive allows of quicker starting and removes the steam, exhaust and drip piping from the auxiliaries. A minor feature that anticipates a discussion of boiler equipment is in connection with superheat on reciprocating auxiliaries. It is an annoying condition for an oiler to have lubricators in superheated steam supplies to engines and pump that will not feed because there is no condensation. It is generally necessary to connect such lubricators to some water line of higher pressure than the steam line, usually the feed water system. For a standby plant, however, unless there is a storage battery in the system, motor drive is out of the question since the auxiliaries must be started before the main generating units.

Before leaving the prime movers a point should be brought out in connection with the generator cooling air. It is a wise precaution to provide a duct for drawing the air from outside the turbine room and from an area free from steam connections. The air should be screened before entering the duct as it is cheaper and easier to clean the screens than to put a generator out of commission for taking down and cleaning.

So far this discussion has dealt with apparatus in which the designing engineer has but little lee-way in the control of the overall station efficiency. Between 65 and 70 per cent. of the total operating cost of the plant is in the boiler room. For this reason big advances have been made in boiler room practice in the last few years.

There is really no opportunity for choice in the type of boiler to be used, at the present time. Recent legislation limits the size of all externally fired boilers to 72 inches. Water tube boilers practically control this field at the present time.

Larger Boilers

There is a tendency now towards larger boilers. This reduces first costs and results in slightly better efficiency. In selecting the number and size of boilers provision should be made to carry the station load with one boiler out for repairs. Boiler rating is based on 1 horse power for each 10 square feet of effective heating surface. In flash boilers a horse power is developed from each square foot of heating surface. Engineers are now endeavoring to increase boiler output as compared with former practice. Boilers are now commonly operated at 200 per cent. of rating over extended periods and even 400 per cent. of rating for short periods. Generating a horse power on 5 square feet of heating surface cuts the first cost of a boiler plant in half.

The only way to obtain this evaporation is by liberating sufficient heat under the boilers and designing to utilize this heat when liberated. Commercial designs of boilers do not allow of a sufficient grate area for hand firing at this rate although grates are installed 12 and even 14 feet deep. This condition, more than anything else, has brought about the recent developments in stokers which makes such operation possible.

This rapid combustion of coal demands radical departures from established practice in boiler settings, flues, stacks and draft arrangement. Forced draft is almost universally installed to provide air in sufficient quantity for the high rate of combustion. Boilers formerly were set close to the grates, five feet or even less being the distance from the firing floor to the tubes. Boilers are now set 10, 12 and even 14 feet above the firing floor. A larger conbustion chamber gives the gases an opportuntiy to become ignited and burned before coming in contact with the tubes. This adds to the boiler efficiency and lessens smoke. The only losses are from the radiation which can be made negligible by means of a well-designed and constructed furnace.

For a standby plant that must respond quickly and be low in first cost stokers with forced draft are a practical necessity. In order to handle the gases on overload operation the flues must be made proportionally larger than in established practice heretofore. Data on flue designs is hard to find and is for the most part empirical. Flues are seldom made too large. The trouble with most boiler plants that do not steam as they should, lies in restricted flue areas One-tenth of an inch water pressure at a boiler damper may be the lacking quantity preventing successful operation. When it is considered that two right angle turns in the path of flue gases introduces a pressure drop of one-tenth of one inch, the necessity for straight simple flues is obvious.

Stacks should be designed of ample cross sectional area for the same reasons as the flues. With forced draft a stack only high enough to deliver gases above the surrounding buildings and to create a natural draft sufficient to draw the gases through the setting producing a balanced condition in the furnace, is necessary.

In a standby plant economizers are not warranted and should not be considered.

In a turbine plant superheat can be utilized to advantage. A gain in from five to seven per cent. can be effected in plant efficiency by superheating the steam from 100 to 150 deg. F., especially where coal is as costly as in Toronto.

Reference has been made to feed water heaters. Feed water heaters should be installed, as they improve the efficiency of the plant very markedly and eliminate undue

strains in boilers due to the introduction of cold water. A selection of type between the closed and open must be made. Open heaters are being used more and more. The first cost is less; they are more readily cleaned; the thermal efficiency is higher, the steam mixing with the water; they afford an excellent opportunity for introducing feed water treatment. Formerly open heaters were objectionable because they returned oil from the exhaust steam to the boilers. This objection is largely removed at present by the development of effective oil separators and the gradual substitution of turbine drive for auxiliaries. This turbine exhaust is free from oil. An open heater must be elevated above the feed pump suction. Supply water to the heater must be under sufficient head to reach the heater elevation. In Toronto this condition requires special pumps to elevate the lake water. For this reason closed heaters are often installed in plants where feed water is not delivered to the plant under pressure. The selection between open heaters with pumps and closed heaters must be studied and made for each plant.

Lake Ontario water is so low in incrusting solids that the simplest treatment renders it excellent for boiler feed purposes.

Feed pumps may be either reciprocating or centrifugal, the latter type having within the last few years been successfully developed for this work. In all cases the operation of feed pumps should be automatic. They should always be ready for immediate service without attention. A standby crew is sufficiently busy putting the plant into service from rest without having to worry about feed pumps. If a centrifugal feed pump is installed the same arguments in connection with steam turbines or motor drive hold good as with the condenser auxiliaries.

Piping is Most Important

The piping of a standby plant is most important. The service is very severe, especially if standby is not required during the night and steam is allowed to drop. It is much more difficult to keep a steam line tight if the pressure is alternately up and down than if the pressure is maintained constantly. For this reason joints are to be avoided and those that are necessary carefully designed. Simplicity is all important in laying out pipe work. The same applies through the entire station design. Complications and duplications that a few years ago were considered desirable are now being reduced to their simplest terms. One boiler feed line built as well and as strongly as modern methods and material permit is superior to a duplicate line in that the first cost is less; the upkeep is less; operation is simpler, and results show that trouble is no more prevalent.

Expansion, contraction, anchorage and drip must be well taken care of. Incorrectly designed steam piping is a source of unending trouble and expense to say nothing of the ever-present danger from a break.

If superheat is used in the plant cast iron fittings and valves must be omitted from the steam lines. Cast steel for fittings and valve bodies is the only successful material at present available for superheated steam. Monel metal is used for valve trimmings with good results. This combination is expensive in first cost but there seems to be no alternative.

The selection of pipe sizes should be made on a basis of velocity of flow for maximum condition of load. Rule of thumb methods formerly applied in selecting pipe sizes. Eight inch connections were recently removed from 184 h.p. boilers operated at about rating at the Scott street plant and replaced with three inch connections, the output having been raised about fifty per cent. by furnace changes.

In a standby plant condensation losses are large if pipes are not adequately covered. The efficiency of a non-conducting covering is mainly controlled by the amount the engineers decide to expend. It pays in lessened operating costs to do it thoroughly.

Coal and ash handling for standby plants is not as important as for plants operating continuously. It is better to keep a boiler room force busy handling coal and ash than to have them sitting around watching it being done by power. The force must be maintained and it is much better to have them busy than idle. This is a subject that must be treated for each plant. There is no general rule in this connection.

In determining the working steam pressure of the plant the tendency is towards higher pressures. Two hundred pound steam results in smaller pipes and apparatus as compared with equal capacity at lower pressure.

International Electrical Congress

In connection with the next Congress of the International Commission which is to be held in San Francisco in September, 1915, it is expected that the General Secretary of the Commission, Mr. C. Le Maistre, of London, England, will shortly pay a visit to Canada and the United States in order to get thoroughly in touch with local conditions and to make preliminary arrangements for the Congress.

Immediately following the Commission Congress there will be held an International Electrical Congress of Engineers, from all parts of the world and representing practically every branch of Electrical Engineering. The papers to be presented, which it is expected will be more than two hundred in number, will cover a very wide range of subjects, and will, of course, represent the most modern research and practice that is known to the world to-day. The Congress is authorized by the International Electrotechnical Commission, and is being held under the auspices of the American Institute of Electrical Engineers, whose President, Mr. C. O. Mailloux, of New York, has nominated the following as Honorary Canadian Members of the Committee on organization, namely.—Dr. L. A. Herdt, of Montreal; Prof. L. W. Gill, of Kingston; Mr. O. Higman, of Ottawa, and Mr. A. B. Lambe, of Ottawa.

Hydro Plant for St. Agathe

The Municipality of St. Agathe, P.Q., are about to instal a hydro-electric plant, designed by Ouimet and LeSage, Montreal. At present there is a small plant of 150 h.p., but this will be abolished, and one of 500 h.p. constructed. The present plant is mainly for lighting purposes; tungsten lamps are used—while the new equipment will be practically all for power purposes, there being a demand for electric energy for several industries which have been established. The development will be on the North River; the power house, of concrete, will measure 30 x 40 ft. The current will be distributed direct from the power house to the various mills, etc. The penstock is to be 1,000 feet long and 6 ft. 3 in. in diameter, and will be built of Georgia pine or B. C. fir. The plant will consist of two units, each of 250 h.p. The horizontal turbines, of Canadian Allis-Chalmers make, will operate under a head of 50 feet of water, working at 600 r.p.m. The oil governors are of the Bell type, supplied by Canadian Allis Chalmers, Limited. The dynamos will be of the alternating current type, 150 kv.a., 60 cycle, 2200 volt, 600 r.p.m., direct connected to the turbine; while the exciters, 125 volts, will be belt driven. There are to be four transformers, two for the potential and two for the distribution system, with the usual panel board and auxiliary equipment.

La Compagnie de Bois et de Construction, Limitee, St. Agathe, P.Q., have obtained the contract for the above work.

Electrical Drive of Winding Engines and Rolling Mills*

By C. Antony Ablett, A. M. Inst C. E., and H. M. Lyons, A. M. I. E. E.

The use of electrical machinery for driving hoisting engines in mines and reversing rolling mill plants in steel works is comparatively recent, the first winders of importance having been introduced in 1902, and the first electrically driven reversing rolling mill being installed in 1906, though non-reversing rolling mills were driven electrically some eight or ten years earlier. The developments along these lines have been extremely rapid, as is shown by the fact that at the present time about one thousand large winding engines and nearly sixty reversing rolling mills are being driven electrically, and still greater developments may be expected in the future.

The earlier winding engines were extravagant in power and had the disadvantage of drawing very heavily upon the source of electrical supply at the moment of starting. It was, therefore, impossible to use them on systems where the supply of current was limited, and even on comparatively

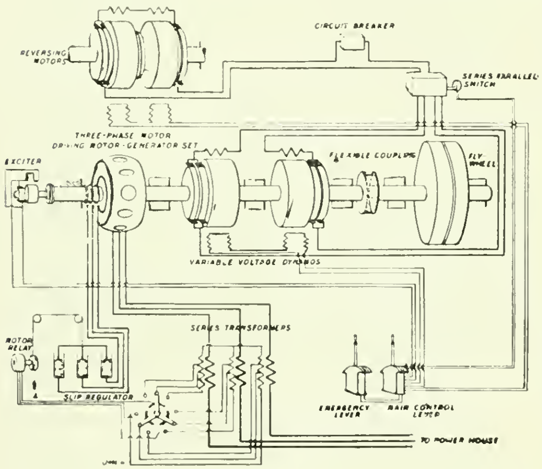


Fig. 1.

large plants their use resulted in serious interference with other machinery. These disadvantages were, however, practically done away with when the Ward Leonard system and Ilgner's adaptation of the flywheel to this system were introduced, but the last few years have seen greater improvements in the Ward Leonard and the Ilgner system.

The present paper will deal chiefly with the developments of these systems by the various Siemens Companies, who have installed about half the total plants in existence, and with whom the authors have the honor to be associated.

WARD LEONARD SYSTEM

A short description of the so-called Ward Leonard System, illustrated in modified form, by the addition of a flywheel, in Fig. 1, is desirable as an introduction. In this system a direct current motor is used to drive the winding engine or rolling mill, the motor being supplied with power from a direct current dynamo, and the essential feature of this system is that the voltage supplied to the motor, and consequently the speed of the motor, is controlled by controlling the field current of the generator, instead of by varying the resistance in the armature circuit of the motor.

* Presented before the Can. Soc. C. E.

Thus, as the field current of the generator is increased from nothing to a maximum, the motor speeds up from standstill to full speed, and if the field current of the generator is reversed, the motor reverses its direction of rotation.

This system enables a very exact control of the speed to be obtained, because the speed of the motor is practically proportional to the strength of the generator field, whatever the load on the motor may be, while with any control system where resistances are inserted into the armature circuit of the motor, the speed would vary within very wide limits with a change of load, rendering the exact speed control quite impossible. The control of the dynamo field involves scarcely any waste of electrical power, but where resistances are inserted into the armature circuit the loss of power may be, and usually is, very great.

The field currents of the generator are small, so that the control mechanism is small, compact and very easy to handle. The armature currents are perhaps fifty times as great, so that any control mechanism which varies the resistance of the armature circuits is large, clumsy and difficult to handle, in fact, a complicated relay system is often necessary to enable it to be handled at all.

The dynamo used to supply the motor in the Ward Leonard system is usually driven by a motor supplied from the available power circuit, forming a motor-generator set, and this motor may be either direct current or three-phase, according to the power available. The dynamo may be and sometimes is driven by an engine, water turbine, or other prime mover, if this happens to be more convenient.

Application to Winding Engines and Hoists

Speed Control.—The main control lever for operating the winding engine is coupled to the regulating resistance in the field circuit of the generator, so that when this lever is in the mid position there is no current in the generator field. As the lever is moved in one direction the generator field current increases, and as it is moved in the other direction the generator field current is also increased, but in the opposite sense. From what has been said in the introductory remarks it will be seen that when the lever is in the mid position, the winding engine is at a standstill, and that it starts and speeds up as the lever is moved from the mid position in one direction, while if the lever is moved from the mid position the other way the winding engine increases in speed in the other direction, and that the speed of the winding engine is practically proportional to the displacement of the lever from the mid position, and is not affected by the weight of material being hoisted.

The driver has not absolute control over the speed, for two cams are provided on the depth indicator, one for each cage, which operate levers coupled to the control lever in such a way as to prevent the cages being accelerated at too rapid a rate, and to slow up the winding engine at the proper point so that the bank is approached at a crawling speed. Provided that these limits set by the cams are not exceeded the speed of the wind is entirely within the driver's control. The depth indicator and the cams are positively driven from the drum of the winding engine and the cams are so geared that they make less than one revolution per wind.

Use of Flywheel.—Fig. 2 shows the typical horse power diagram for a winding engine. The inertia of the drums, cages, head sheaves, material wound, and the ropes, which altogether weigh about 60 tons in this particular case, necessitates a horse power at the end of the acceleration period of each wind of 1865, which is about three and a half times the

average power demand of the winding engine, in this case 524 horse power, and it is found that the maximum acceleration peak is usually between three and four times greater than the average demand.

The consumption of energy for this Ward Leonard control rises gradually during the starting period, and the maximum is only reached at the end of the time of acceleration, i.e., from ten to fifteen seconds after the start, because the speed of the winding motor is increased while it is giving the requisite turning moment by increasing the field of the generator, and consequently there is no loss of power in starting.

Since the acceleration peak is of short duration and only comes on gradually, it is possible to supply Ward Leonard winders from power stations of comparatively small total output, provided that the machines in the power station have a sufficient overload capacity to maintain their speed during peak loads, as is usually the case with steam turbo-generators where the generators are provided with modern voltage regulators.

Where, however, this is not the case, and the acceleration peaks of the winding engine are large compared with the average demand on the power station, or where the winder is supplied through a long transmission line from a distant power station, it is sometimes necessary to couple a flywheel to the motor generator set.

This is the Ilgner system, so-called after the engineer who first used it in practice.

Fig. 3 illustrates the effect of the flywheel in equalizing the load taken by the winder, where it will be seen that the current taken by the winding motor varies between + 1900, and — 1000 amperes, while the current taken from the supply system is maintained practically constant at 400 amperes, the maximum voltage supplied to the winding engine and the supply voltage being the same.

The following example will give an idea of the power taken by the Ilgner system under practical working conditions with a winding engine arranged to wind 240 tons per hour from a depth of 1960 feet, making as a maximum 14½ winds per hour, where the flywheel is used whenever the full output is being wound at the full speed, but when a lesser output is being wound at reduced speed, so that the acceleration peaks become less serious, the flywheel is uncoupled to save power. These results are conveniently expressed in terms of the kilowatts taken by the electric winding engine plant per shaft horse power.

	Output in tons per hour.	Kilowatt per Shaft Horse Power.
With Flywheel	240	1.49
"	160	1.60
"	108	1.77
Without Flywheel	160	1.35
"	108	1.48

It will thus be seen that when working the winding engine on the Ilgner system there is an increased loss of power of from 16 per cent. to 17 per cent., as compared with the Ward Leonard system, and naturally with the latter where the flywheel is uncoupled the resistances are cut out of the rotor circuit of the three-phase motor to avoid loss of power.

To avoid misunderstanding of the above results, it should be specially pointed out that shaft horse power is taken to mean the actual work done in raising the load, i.e. if the actual weight of coal or ore, expressed in lbs., which is raised per minute is multiplied by the depth of the shaft in feet, and divided by 33,000, the shaft horse power is obtained. The shaft horse power thus does not include the mechanical friction of the winding engine, the sheaves, the guides or the rope losses, and the figure of the kilowatts divided by the shaft horse power brings in the mechanical efficiency, as well as the electrical.

Details of Ilgner System

Of recent years the capital cost of Ilgner plants has been greatly reduced, owing to the adoption of higher speed for the motor generator sets and to the improvements in the manufacture of such fly wheels, which enables them to run at very high peripheral speeds compared with those used in the earlier winding engines.

For example, the provision of flywheel capacity to equalize peak loads of 60,000 horse power seconds, in the early days of Ilgner winding, where peripheral speeds of 15,000 feet per minute were used, would require two flywheels of a total weight of about 80 tons, the friction and windage loss of which would be about 150 horse power. Under modern conditions where the regular peripheral speeds are 27,000 and

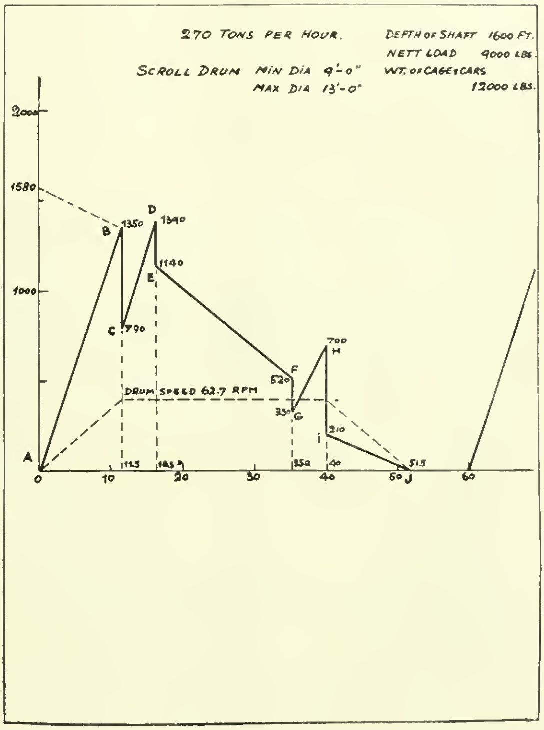


Fig. 2.

30,000 feet per minute a single flywheel of 22 tons weight would be used, instead of the two flywheels having a total weight of 80 tons, and the friction and windage losses would not exceed 100 horse power.

The Ilgner system was used on practically all the early European winding engines, but as at the present day power stations are being installed of much greater capacity than those of a few years ago, and high speed turbo-generators of large overload capacity are being adopted, the Ward Leonard system at the present time is being used to a much greater extent than the Ilgner system for winding engine work.

Generally speaking, the Ilgner system of winding may be preferable to the Ward Leonard system in the following cases:—

(1) When the time occupied by the wind is short.

(2) For vertical shafts.
(3) For large outputs.
(4) Where the winding speed is very high.

The above conclusions may be considerably modified by the nature of the electrical supply. Where the power station is small or the winder is supplied through a transmission line of considerable length, the Ilgner system will be more suitable, but where the power station is large and near the winder, the Ward Leonard system is the better.

Brake Gear

The mechanical brake is so arranged that when it is required to bring it into action it is actuated by a weight at the end of a lever, but it is normally held off the drum by an air cylinder.

Under normal conditions the cams on the depth indicator actuate the control lever, so that the cages approach the bank at a very slow speed. When they reach the bank the driver brings them to rest by means of his control lever, and then puts on the mechanical brake to hold the cages in position by means of the brake lever. The brake lever is interlocked with the control lever, so that the driver cannot put on the brake by means of the brake lever until the control lever is at about its middle position, i.e., unless the cages are moving at a comparatively slow speed.

To enable the driver to stop the winder in case of any emergency arising, a third lever, the emergency lever, is placed on the driver's platform and if this is operated it puts on the mechanical brake through the emergency gear and at the same time cuts off the excitation from the dynamo of the motor generator set.

Fig. 3.

Safety Devices

As mentioned above, cams are provided on the depth indicator which keep the acceleration within safe limits, and the cage is brought gradually to a slow speed by the time it reaches the bank. An overwind device is provided, usually both on the depth indicator and in the shaft, which puts on the mechanical brake through the emergency gear and cuts off the excitation should the cage overwind the bank, thereby bringing the winding engine instantly to a stop. Should the air pressure or the excitation fail, the mechanical brake is put on by means of the emergency gear.

When men are being wound the throw of the main control lever is limited by means of a switch on the bank, so that the winding engine cannot be run above a certain speed.

Where electrical driving is adopted it is very easy to provide safety devices, and all those mentioned are designed to protect the plant against careless handling, but if the majority of safety devices were dispensed with, the Ilgner and the Ward Leonard winder would still be better protected against careless handling than the steam winder. The fact that it is impossible for an Ilgner or a Ward Leonard winder to race or run away makes it inherently safer than the steam winder.

Application to Reversing Mill

Nearly 60 large reversing mills are being driven electrically in different parts of the world and a modification of the Ward Leonard system has been installed in almost every case to meet these special requirements.

The power requirements of a reversing rolling mill impose much more severe conditions on the electrical plant than those of a large electrically driven hoist. With a large 36-in. or 45-in. blooming mill, ten to twelve passes are often made in a minute, and the power during individual passes may rise to 12,000 h.p. or more, while the total time of the passes, i.e., the total time that the ingot is between the rolls, is very short compared with the total time taken to roll an ingot down to a bloom or billet. It is thus easily seen that the average power required from the power station is very much less than the maximum power which the mill motor has to give.

For example, in many electrically driven blooming mills, the average power is only one-sixth or one-seventh of the maximum power.

In the case of an electrically driven hoist, the duration of a wind would be perhaps one minute, followed by a pause of 20 seconds or so, and the maximum power required seldom exceeds 3,000 to 4,000 horse power, so that the average power is of the order of one-third of the maximum power. While, as has already been pointed out, it is frequently necessary to employ flywheels with winding engines it is always necessary to couple a flywheel to the motor generator set which supplies a reversing rolling mill motor.

A reversing rolling mill motor, on account of the rapidity with which it has to reverse, must be so designed that its moment of inertia is kept down to a minimum and special precautions must be taken to see that the field of the generator supplying this reversing motor should build up as rapidly as possible. This has been accomplished so successfully that it has been found possible to reverse a large reversing mill motor having rotating parts weighing over 70 tons, 30 or 40 times per minute between a speed of 60 revolutions in one direction and 60 revolutions in the other, when no steel is being rolled. Such tests naturally cannot be made while steel is being rolled because it would be quite impossible with the present type of live roller tables to return the ingots to the mill quickly enough, but such tests are useful in showing the very high rate of acceleration of the mill motor which can be obtained, and as a measure of the handiness of the mill.

Power Diagram for Reversing Blooming Mill

Under ordinary conditions the power diagrams for each wind of a hoist are identical and can be calculated with considerable exactitude from the conditions of working, but with a rolling mill the power diagrams for each pass vary very greatly from one another, and cannot be calculated with any accuracy, for the following reasons.

During the earlier passes heavy drafts are taken but the ingot is quite short, consequently large powers are required for very short times; but as the ingot is gradually rolled out to a bloom of considerable length and reduced in section the drafts are diminished, as the reduction in area must be kept moderate, otherwise the bloom is damaged by the formation of surface cracks, etc., so that during the last passes the necessary power is not very great, but it is required for a considerable time.

During the first two or three passes the ingot still has its tapered shape and the metal is very spongy in character, so that the powers required are not very heavy and are very irregular. By the time that the last passes are taken the bloom

has cooled down considerably and while this cooling increases the specific power required, such drafts are taken that the power required for these passes remains much less than that for the first passes.

Action of Flywheel

There is a great difference between the behaviour of the flywheel coupled to the motor generator set used for driving a hoist, and that used for driving a rolling mill. In the case of a hoist where the power diagrams for each successive wind are almost identical, and about an equal period elapses between each wind, the flywheel gives up power during a wind and regains it during the interval, thus serving to equalize the power between individual winds and intervals. In the case of a rolling mill, and particularly a blooming mill, the flywheel has to do a double duty, because during the first passes made on an ingot the mill motor has to give a large power for a very short time as the ingot is short, so that the energy consumption during the earlier passes is much less than the energy consumption during the later passes, where, although the power given by the motor is not so great, the ingot has been rolled out to a considerable length, so that a very considerable energy is required per pass. The flywheel, therefore, has to give up energy during the passes and regain it during the interval between passes, and also the flywheel gains energy during the first passes of an ingot and loses energy during the later passes, so that its speed variation has a double period, namely, a short period of about 5 to 10 seconds, corresponding to the partial equalization of power between the pass and interval, and a long period of about 3 minutes, corresponding to the equalization of power over the whole time of rolling an ingot.

As the flywheel used in connection with a rolling mill has to equalize the power over a period of three minutes or so, it is usually found that these flywheels are much heavier than those applied to winding engines. The motor generator set for a blooming mill is usually supplied with a flywheel weighing about 40 tons, while a motor generator set provided for a plate mill, or a finishing mill, is generally supplied with a flywheel weighing anything from 60 to 100 tons, depending on the work which has to be done. The motor generator set for supplying hoists or winding engines is generally provided with a flywheel of not more than from 20 to 30 tons. Such flywheels would run at a peripheral speed of about 20,000 per minute, though in some cases this peripheral speed has been considerably increased.

Such a 100-ton wheel running at this speed would have a stored energy of about 300,000,000 foot lbs. or 545,000 horse power seconds, and in falling 20 per cent. in speed would give up 108,000,000 foot lbs. or 195,000 horse power seconds.

The total work required to roll a 1½ ton ingot to a 4¾ x 4¾ billet is 59,000,000 foot lbs. or 108,000 horse power seconds.

Safety Devices

The safety devices provided for an electrically driven rolling mill are of a much simpler character than those provided for a hoist, because it is not necessary to provide against the possibility of an overwind or the loaded cage falling to the bottom of the shaft due to the failure of the electric power. It is only necessary to protect the electrical plant and the mill itself against careless handling.

A circuit breaker is provided in the main circuit between the generator of the motor generator set and the mill motor to cut off the power from the motor in case, through carelessness, an attempt is made to roll a cold ingot, or too great a draft is taken on an ingot, imposing a greater strain on the motor and mill than they were designed for.

The circuit breaker is a protection against broken rolls as well as against damaging the motor, and it must be remembered that many rolls, especially the bottom roll, have a very small factor of safety. Such a circuit breaker would be most objectionable if used with a hoist, as only the prompt application of the brakes would prevent the cage falling in the shaft when the breaker opened, but with a mill, when the circuit breaker acts the motor merely comes promptly to a standstill, and if there is an ingot between the rolls, the mill can be reversed, the circuit breaker put in, the ingot run out of the mill again, and no damage is done.

A good deal of space in this paper has been devoted to description of safety devices but it should not be considered on this account that there is any inherent risk in using such electrical plant, as the safety devices are to protect the plant against damage due to careless handling. The devices applied to steam hoisting engines, and particularly to steam reversing rolling mill engines, are of a much more rudimentary description, and the safety of such steam plants really depends on the skill and experience of the driver.

It should be particularly pointed out that the electrically driven reversing mill does not increase in speed as the ingot passes out of the rolls, while the steam engine, unless carefully handled, will race and run away.

APPLICATION OF THREE-PHASE MOTORS

A three-phase motor cannot be built for a very low speed without its power factor being bad, which tends to upset the regulation of the supply system, and for this reason where three-phase motors are driving winding engines they nearly always run at higher speeds than the drums, and are geared to them. In the Ward Leonard or Ilgner system, however, where a direct current motor is used, this is almost invariably direct coupled to the drum.

Control

The speed of a three-phase motor is controlled by varying the resistance in the rotor circuit so that all three-phase winding engine motors are naturally slipring motors, while the direction of rotation is reversed by interchanging two of the connections to the stator, so that a reversing switch must be provided for this purpose. In order to explain the differences between the control of a three-phase winder and that of a Ward Leonard winder, it is necessary to refer briefly to the behaviour of a three-phase induction motor when resistances are connected in the rotor circuit.

If the proper resistances in the rotor circuit of a three-phase induction motor are connected to reduce the speed by a given amount for a definite turning moment, the speed of the motor will increase if the turning moment which it has to give decreases, and it will decrease if the turning moment increases. It will thus be seen that while with a Ward Leonard or Ilgner winder, the winder runs at a definite speed for each position of the control lever, and the speed of the winder is independent of the load in the cages, with a three-phase winder the speed does not solely depend on the position of the control lever, but also depends on the turning moment which the motor has to give, so that for a definite position of the control lever the speed may vary according to the position of the cages in the shaft and according to the load that is being hoisted, for as the loaded cage is being hoisted, its weight becomes more and more balanced by the weight of the rope attached to the empty cage.

With the three-phase winder, therefore, the manipulation of the levers would be different as different loads are being hoisted, and it is therefore impossible to employ cams on the depth indicator to limit the acceleration and to bring the loaded cage to a slow speed by the time it reaches the bank.

In the three-phase winder, therefore, we come back to the case of a steam engine where the wind is entirely in the hands of the driver and reliance must be placed in his skill for the safe handling of the plant.

(To be continued)

Electric Railways

3-phase Railway Operation in Italy

Details of the latest developments in 3-phase railway electrification on the Italian State Railways have recently been published in the official journal of that Government. We are indebted to "The Tramway & Railway World" for the following translation:—

So far as Great Britain is concerned the developments of electric traction upon main line railways have taken the direction of employing in nearly every case a third rail as conductor and continuous-current motors. Indeed, so far, the bold step taken by the London, Brighton, and South Coast Railway, in converting their suburban lines to electric traction upon a single-phase alternating-current system of line working, with overhead conductors throughout, constitutes the chief instance at present of such a method in regular service in this country; but its apparent success in working justifies extension, and it may be that in future more examples of the system will be put into operation upon long-distance runs, as well as for sections where traffic is heavy and junctions numerous.

The Italian railway authorities, perhaps partly because of the success of three-phase alternating-current working upon the Valtellina line, have continued to install the same system on other lines in preference to third-rail continuous-current working, and we have now to record the progress of further stages in the equipment of the main lines of the Italian State Railways near Genoa for electric traction, with overhead conductors and alternating-current motors.

The new method of traction has already practically doubled the tonnage per hour of the line where at present working. The average trains consist of 21 wagons of 18 tons each. The line is divided into three sections, and the trains run at intervals of 15 minutes. With a period of 18 hours per day there are, therefore, 1,058 wagons running over the line, or with a period of 20 hours per day, 1,176 wagons can be dealt with. At a 10 minutes' interval these figures are increased by 50 per cent.

The 40 locomotives for the line represent the latest developments in three-phase machines. Each has a capacity of 2,000 h.p., and a total weight of 60 tons; this, of course, represents an output of 33.3 h.p. per ton. These locomotives have five coupled axles with wheels of 42 in. diameter. The two axles at each end have a lateral play of 7/8 in. The central wheels have no flange—an arrangement which allows the locomotives to run freely round curves of every small radii without difficulty.

As delivered, the new Giovi locomotives were designed for freight service, and for a normal speed of 28 miles per hour. They are, however, also used for passenger service, as their speed capacity is as high as it is considered safe to work on the Giovi line. They have, in addition, a 14 miles per hour speed which is used for shunting purposes and for generating power when the train is running down hill.

Trains of 418 tons, exclusive of locomotive weight, have been run at speed of 28 miles per hour up the grade from Pontedecimo to Busalla, a distance of 6½ miles. On the down grade, as mentioned, the speed is 14 miles per hour, the locomotive being connected for regenerating power. During the original tests after 20 hours' continuous operation, one round trip without forced ventilation of the motors was made with a temperature rise of the motors to somewhat less than 167 deg. Fahrenheit. The one-hour motor rating for the same temperature is 720 h.p. per motor, corresponding to a locomotive pull at the wheel circumference of 19,500 pounds. The friction rating under the most unfavourable conditions is such that a train of 380 tons, exclusive of the locomotive, can be accelerated to 28 miles per hour in less than 200 seconds by two locomotives, one pushing and one pulling, on a grade of 1 in 28.6, and on a curve of not less than 1,200 ft. radius. The maximum starting torque is such that the motors can revolve the wheels of the locomotive, with its weight increased to 75 tons, while the locomotive is kept stationary.

The motors are three-phase, 3,000-volt, 15-cycle machines, arranged to run in cascade and parallel, giving two synchronous speeds of 112½ and 225 revolutions per minute. Intermediate speeds are obtained by inserting rheostats in the circuit. The motors have double bearings, the outer of which is built into the main locomotive frame and carries the reactions of the frame; it also takes the thrust of the connecting rods, and is provided with springs to take up all motion or change of position due to shocks, weight of ballast on locomotive frame, etc. The inner bearing carries the motor, and has for its special function the maintenance of the air gap, so that the motor itself is entirely independent of any motion of the locomotive frame. The mounting of the motors on the locomotive is accomplished from below by means of a hydraulic lift. The complete changing of a motor, including the connection to the side rods, may be easily done in two hours.

Control System

The control system embraces a number of excellent features. Since the starting resistances are of water rheostat type, it was necessary to design the secondaries of the motors for low potential; this was also desirable in order to have low potential on the slip rings. The low potential secondaries involve, however, the possibility of connecting one of the motors in cascade connection. The switch performing this reconnecting of one of the stators from high to low voltage is the only switching mechanism in the system, which has numerous contacts for heavier currents. It can in this respect be compared with either the auto-transformer tap switch of the single-phase system and poly-phase systems with squirrel-cage rotors, or with the resistance distributing switches of systems using metallic starting resistance; but its practical operating characteristics are much superior. Since it is always operated without current the necessary care and cost of maintenance is reduced to less than 10 per cent. of that of the other switches mentioned, and it may be operated by only two relays, while the others, under master switch control, require relays for all tappings.

The wiring required in connection with the potential

changing switch is reduced to a minimum by mounting the switch directly on the motor and handling it as a unit therewith. The switch extends into the cab of the locomotive from below, and may be readily inspected by removing the protecting cover.

The use of the water rheostat is one of the main advantages of the control system. It eliminates all metallic resistance parts, which are always more or less subject to burnouts and mechanical breakage. Moreover, all contacts that have to be operated under current in the secondary are eliminated, excepting the one contact which short-circuits the rheostat. On this contact, however, there is no arcing and burning, since it operates only when the water rheostat is about zero.

A further advantage of this control lies in the fact that it does not increase the current by steps, but allows for the finest possible regulation.

The water receptacle is a tight tank so mounted as to extend below the cab for air cooling. Receptacles for the electrodes extend from below the water level, through the cover and up into the lower parts of the locomotive, the electrodes being supported in the upper portions of these receptacles or cylinders. In operation, the height of water in the cylinders is regulated by air pressure in the upper part of the tank, which forces the water up into the cylinder, and the regulating mechanism extends into the cab proper, and can therefore be conveniently inspected after the removing of a protecting cover.

The only switch that is interrupted under current is the primary switch, but even for this switching conditions are very favourable, as the current to be interrupted in the primary of induction motors with wound secondary may be reduced practically to the magnetising current by first inserting resistance into the secondary, and then breaking the primary current. For this reason it has been found possible to use switches which, after an operation of two years, are still in good working condition. The excellent feature of the primary of the Giovi locomotive is that it serves as both an interruption switch and a reversing switch, without requiring any additional contacts for the reversing. This is accomplished by simply rotating the movable contact parts through a certain angle, in order to reverse the motor.

The master switch is arranged for two levers. One of the two levers has four definite positions, corresponding to the two speeds, to move forward and backward. The second lever regulates the current consumed by the motors. Every position of this lever determines positively the certain maximum current to be taken by the motors. Any time the motor tends to take current larger than corresponding to the lever position, resistance is automatically inserted into the secondary. The lever acts on the armature of a small induction regulator, and thereby regulates the secondary potential of the regulator; the induction regulator secondary is connected to one coil of a relay, which is counteracted by the second coil, the current of which is proportioned to the motor current. Whenever the effects of the relay coils are balanced, the armature is in the middle, and the motor currents remain unchanged; as soon as the motor current increases the armature is attracted by the one coil, and closes the relay circuit, which increases the resistance in the secondary. The fact that each locomotive can be set for a maximum current would make it possible to use the locomotives in multiple without a special multiple control. Nevertheless, a multiple-control arrangement is provided for. The special controller, allowing for all desired conditions, is provided in connection with this system. The multiple-control system not only permits the operation of locomotives of different wheel diameters in multiple and equally loaded, but also permits the loading of them differently with any desired ratio of load distribution. This is a great advantage, as it is frequently desirable to keep the drawbar pull of a pulling engine within certain limits, and let the pushing engine take care of the greater part of the load.

The coils operating the valves are of a very simple design, and work exceptionally well, even if the potential drops to half its normal voltage.

An important feature—already alluded to—of the three-phase installation has been found of great value in the utilization of regenerated power from the descending trains; this reduces the cost of operating the line, and also reduces, by proper arrangement of the schedules, the peak of the load in the generating station, further avoiding the use of mechanical brakes when the train is going down grade.

Pantograph Arrangement

The pantograph arrangements are also very simple. The single bow with two bronze cylinders insulated from each other and revolving in ball bearings engages both overhead wires. The use of the rolling contacts is very favourable for the contact wire, and has given good results on the Valtellina line, where it has been in use for over 10 years. On this line the rolling contacts were changed after an average of 25,000 loco-kilometres (not including shuntings), with a current often greater than 200 amperes per contact. In the Simplon tunnel, where sliding contacts are used, they were changed after 2,700 loco-kilometres on the average. This great difference is due to the fact that the contact point on the rolling type is changing very rapidly, so that the melting of the metal which reduces the life of the contact on the sliding type is not possible.

The construction of the trolley line is identical with that actually in service on the Simplon line. It consists of two wires of 5-16 in. diameter, suspended over the centre of each of the two tracks, supported by transverse wires carried upon steel poles placed upon each side of the track. The rails are electrically bonded and connected with the sub-stations, and serve as a third conductor.

Transmission Line

The transmission line consists of a double feeder cable from one extremity of the route to the other. It has been erected with all the latest improvements for the use of 13,000 volts. It feeds four transformer stations, situated on the route between Genoa and Ronco, at Rivarolo, Pontedecimo, Montanesi, and Busalla. Each of these consists of a small building of brick and concrete, containing a three-phase transformer of a nominal capacity of 3,600 kv.a. of the oil type, reducing the current from 13,000 volts to 3,000 volts tension for feeding the overhead wires. The transformers, which are only designed for 13,000 volts, can, by a change of the connections, be adapted to 22,000 volts. When this change becomes necessary a third group can be installed in the central station, and three alternators arranged for working at 22,500 volts. The entire line is divided into sections, and suitable measures have been taken to ensure an independent current supply to each of these sections so that in case of damage a section can be promptly cut out for repair without interference with the others.

At the generating station, which is situated at Chiapella, on the harbour side in Genoa, the first installation comprised two groups of three-phase steam turbo-alternators, each of 5,000 kw., 13,000 volts, 15 periods, each group being designed to carry an overload of 100 per cent. for five minutes. Space has been reserved for the installation of the third group above referred to. The work will soon be well in hand upon the construction of hydro-electric plants from which a supply of electricity will be obtained for operating these lines, and the Chiapella steam station will then be held in reserve as a standby.

Do Low Fares Increase Riding?

By M. Irwin Fullerton, District Auditor D. U. R.

For many years city street railway operators in the United States have been informed that a reduction in the rate of fare would not be detrimental to their interests because the increased riding would offset the reduction in the rate, or, in other words, that if the 5-cent fares were reduced to 3 cents there would be so much more riding on the cars that the gap in the gross receipts caused by the 2-cent reduction in fare would be closed. It is sufficient to say that the avenues through which this really marvelous theory of economics has been propounded have not been street railway operators or expert investigators. In the main, this argument has been advanced by organizations or individuals whose knowledge of electric railway matters has been, to treat it kindly, academic rather than practical. The absurdity of the premise as a general proposition will be apparent because if it were followed to its logical conclusion a 2-cent fare should be much more desirable than a 3-cent rate, and a 1-cent fare would be better than either.

Within the last six months the Detroit United Railway has had opportunity to observe the effect of a lower rate of fare upon the riding habit. Since August 15, 1913, under a temporary day-to-day agreement with the city, a seven-for-a-quarter rate has prevailed as the principal fare factor, as compared with a straight 5-cent fare previously. The difference in the rate will be generally acknowledged as sufficient to give a fair test of the theories of the low-fare advocates. What has been the result?

The following table shows the percentage of increase in passengers carried during the last thirteen months over the same months a year ago.

With 5-Cent Fare		With 7 for a Quarter Tickets	
Month	Per Cent Increase	Month	Per Cent Increase
January	20.53	†August	16.03
February	16.89	September	19.42
March	20.41	October	16.41
April	17.41	November	14.65
May	18.15	December	13.39
June	15.17	January, 1914	12.38
*July	9.53		

*July, 1912, traffic above normal. †Fifteen days in Aug. were under 5c. fares.

It will be observed that in both January and March of 1913 the percentage of increase was greater than in September, the month which shows the largest percentage of increase in passengers of all since the low-fare agreement has been effective. The average increase for the last four months of 1913 under the lower fare was 15.91 per cent., as against an increase of 19.34 per cent. for the first quarter and 16.87 per cent. for the second quarter of 1913 under the 5-cent rate. It will also be observed that there has been a steady decrease in the percentage of increased passengers carried in each succeeding month since the low-fare arrangement, October dropping 3 per cent. under September, December 3 per cent. under October, and January, 1914, 1 per cent. under December.

With these statistics it is exceedingly difficult, in Detroit at least, to reconcile the theories of the low-fare advocates with the results obtained in actual practice. As a matter of fact, the conclusion is inevitable that the average rider on city railways uses the car because he wants to get to some particular place for business or pleasure. If there is any percentage of the public which uses the street car for pleasure-riding purpose or travels simply for the ride, it is imperceptible. If there has been any increase in the short-distance riders because of the lower rate, it certainly is not distinguishable.

It would seem evident that there are factors which affect the riding habit much more than the rate of fare. Industrial conditions and rapid or retarded growth in population should be regarded as the most important of these other factors.

There is a phase of the lower-fare more-riders theory which has been either overlooked or disregarded by its advocates, yet it is a phase which has a very important bearing upon the finances of a street railway. If it were true that increased riding followed fare reduction, it is unquestionable that increased transportation facilities must follow, with a consequent increase in cost of operation, and if the gap in receipts between two rates of fare could be equalized by a larger patronage at the lower fare, there must still be taken into account the larger drain upon the treasury caused by the cost of the increased service.

Whether it is really beneficial to the public to have lower fares is a broad question with plenty of arguments on both sides. But it must be recognized that if fares are reduced to such a point as to give a bare margin over operating expenses, street railway companies will not be able to provide the service which they could supply under more favorable fare conditions. Sometimes cheap rides are not economical for the public, and it is reasonable to believe that the individual rider will be better off in the end if he forgoes the small saving which he might make under a lower rate of fare and places the quality of service as the first consideration in his mind. So long as the product of the street railway company has a fixed price and its expenses work on a sliding scale with the trend continually upward, it is a mathematical certainty that the public cannot receive more than it pays for.—Electric Railway Journal.

"Safety First"

A small folder entitled Safety First is being distributed by the Toronto Railway Company among their employees. This folder is issued by the Ontario Safety League, which was organized in September, 1913, under the suggestion of the Ontario Railway & Municipal Board. A campaign was started early in the present year and since that time the association has spared no effort to educate the public into the full meaning of the words "Safety First." Local branches will be organized throughout the province which will be under the direction of the parent League with head office at Toronto. This is being accomplished by lectures, literature, blotters, circulars, warnings placed conspicuously on billboards, street car signs and through the newspapers. In addition to this a free moving picture show entitled "The Price of Thoughtlessness" is being given in Toronto for the benefit of the children.

The following is the text of a letter to the officers and employees of the Toronto Railway Company by the general manager, Mr. R. J. Fleming, which indicates the interest taken by this company in the "Safety First" movement.—

"You are no doubt aware of the fact that an association has been formed in the city of Toronto, having for its object the prevention of accidents and injuries to human life. This association is known as the Ontario Safety League and its formation is mainly due to the untiring efforts of Mr. Andrew Ingram, Vice-Chairman of the Ontario Railway & Municipal Board.

I am taking this method of informing you that it is the intention of our company to do all that it can to promote the welfare of the League in attaining its object as above mentioned. You will readily understand that this can best be accomplished by the hearty co-operation and personal effort of each one of us. I therefore strongly recommend that you join the league as soon as possible. It being my hearty desire that every employee of our company take a personal interest in this humanitarian movement."

Illumination

The Field of the Gas-Filled Mazda Lamp *

By Mr. S. H. Blake

The advent of a radically new illuminant into practical use always means that there must be a readjustment of established lighting practice in order to make room for the new-comer. Such a transition is now commencing, owing to the recent appearance of the wonderful gas-filled mazda lamp. It is interesting to consider briefly the prospective field and scope of this new light source in its present state of development.

It is very difficult to compare directly and to classify the various methods of producing artificial light, owing to the many varying factors that must be considered and weighed as to their relative importance. Furthermore, the particular qualities that make a certain light source well suited for some purpose make it entirely unsuitable for other equally important applications. The gas-filled mazda lamp, however, is strikingly attractive from almost every standpoint, as it embodies in one unit the desirable qualities of the incandescent lamp, namely, steadiness of light, constant color value, cleanliness in operation and low maintenance labor cost, etc., together with high efficiency and good quality of light when compared with the present standard practical arc lighting units.

Owing to the fact that the gas-filled mazda lamp in its present form gives its highest efficiencies when it is made for about twenty amperes, or more, the fact at once becomes apparent that this new lamp is highly suited for series connection. The only practical method of operating such high current lamps on direct current constant potential circuits will be to connect them in series-multiple, whereas for alternating current constant potential connection, they may be operated either in series-multiple or from individual or group step-down transformers or compensators. If the lamps are made suitable for direct, single connection across one hundred and ten volts a.c. or d.c constant potential, they will operate at a very appreciably lower efficiency than when made for high currents.

Even a casual consideration of the few essential characteristics mentioned will indicate that there are really two types of gas-filled mazda lamps with a well defined line of demarcation between them.

First, there is the real gas-filled mazda lamp, as we may call it, operating at high current and low voltage, the efficiency of which compares favorably with that of the magnetite arc lamp; and, second, there is the low current gas filled mazda lamp which is practically an improved mazda lamp operating, to be sure, at attractive efficiency, but not, at the moment, in the same class with the high current lamp. In fact the only excuse for the low current type is that it can be operated on existing circuits without auxiliary devices, whereas the practical economical use of the high current lamp will involve the design and production of new apparatus and fixtures, as well as some changes in connections and practice.

For example, if it is desired to operate a 20 ampere gas-filled mazda lamp from a 110-volt constant potential circuit it will either be necessary to connect several of them in series, the number being dependent upon the candle-power of the lamps, or else if the circuit is alternating current a small transformer or compensator can be used to step the voltage down to the correct value for the lamp. Such a transformer or compensator should be preferably mounted with the lamp itself. The whole combination should have a cover or casing to give it a pleasing and finished appearance and to protect the lamp, socket and windings from weather conditions when used out-of-doors. Arrangements should also be provided for attaching suitable reflectors and provision should be made for a globe-holding device, as not only will diffusing globes sometimes be desirable but the hot glass bulb of the lamp should be properly protected from possible fracture due to rain, snow or sleet. It is also important that this whole structure be well ventilated so as to keep the interior parts as cool as possible. Thus, it is at once evident that special fixtures, etc., are necessary to properly use high current, gas-filled lamps in actual service. If it is desired to use the 20 ampere lamps on existing series street lighting circuits, it becomes at once apparent that either the street wiring suitable for 7.5 and 6.6 amperes will have to be replaced with heavier wire, to say nothing of the rewinding of current regulating devices; or else individual series transformers or compensators will have to be used, as with the multiple lamp, involving complete fixtures, etc

The use of these transforming devices for running multiple and series gas-filled lamps will, of course, lower the operating efficiency of the lamps and also reduce the power-factor slightly; but the greater efficiency of the high current lamp makes it well worth while to use it in this way instead of using the low current lamp without transformers This procedure is further influenced by the fact that the large, rugged filament of the high current lamp should be expected to give longer and more reliable service than the thinner filament of the low current lamp.

It is significant to note that even the low current gas-filled mazda lamp compares very favorably with the multiple arc lamp, particularly on d.c., as the ballast resistance necessary to make such arcs stable on constant potential greatly reduces the input watts per candle efficiency, whereas no such loss is necessary in operating the gas-filled mazda lamp. To a less degree the efficiency of the a.c. multiple arc lamp is lowered by the losses in the ballast reactance, but the power-factor of such lamps is about 30 per cent. lower than that of the gas-filled mazda lamp. In this field it is, therefore, probable that the gas-filled mazda lamp will become supreme except where conditions of severe vibration and rough handling make an incandescent lamp unsuitable, and in cases where the penetrating powers of the rays from the yellow flame lamp make it more effective.

For constant current connection the arc lamp is not handicapped to the same extent that it is for multiple operation, and before it can be predicted with any degree of ac-

* General Electric Review.

curacy just how far the gas-filled mazda lamp is liable to encroach into the field of series street lighting now practically dominated by the arc lamp, it will be necessary to determine by actual experience whether the gas-filled mazda lamp is inherently rugged and reliable enough to economically withstand the very trying conditions of this truly American method of operating street lamps.

The gas-filled mazda lamp will apparently meet European conditions better than it does ours in this country, owing to various causes. The practice in large cities abroad is to light the city proper with high candle-power units, generally arc lamps operating two or three in series on 110 volts or 4, 5 or 6 in series on 220 volts constant potential. These lamps are hung very high, quite close together and often are directly over the centre of the streets. High candle-power gas-filled mazda lamps should work out well under such conditions, as they throw a bountiful amount of light directly below the lamp. The steadiness of the gas-filled mazda lamp is another great point in its favor from the European standpoint, while its yellowish white quality of light will be much superior to the light of the yellow flame lamps that are now used there so extensively.

The perfect steadiness of the gas-filled mazda lamp will also be a very decided point in its favor in this country, particularly for the lighting of large interiors, doorways and in front of buildings. For street illumination it will be an interesting study to watch the progress it makes against the magnetite lamp, which is undoubtedly a remarkable lamp for street lighting due to its beautiful white color, its ideal light distribution, and its low cost of maintenance. The "life" of the gas-filled mazda lamp will largely determine its success in this field, for the cost of even one renewal will be a relatively large part of the yearly maintenance cost of one magnetite lamp.

As to flame, quartz, titanium and other high efficiency lamps the introduction of the gas-filled mazda lamp instead of tending to discourage their further development should greatly aid to still more perfect them. Even now the efficiencies that it is possible to obtain with some of these lamps are twice as good as the best that can be secured with the gas-filled mazda lamp. The general effect of the gas-filled mazda lamp on such other lamp developments will probably be to enhance the relative commercial importance of the qualities of steadiness and constancy of color values and to redouble the efforts already being made to obtain still higher efficiencies. These several qualities will be sought in arc lamps by using higher currents and smaller diameter electrodes.

It would be entirely premature at this time to try to analyze the probable cost of operation and maintenance of the gas-filled mazda lamp compared with other lamps for equal illumination of streets, but it is not unlikely that such a comparison would show that the titanium and flame lamps are the most economical, practical illuminants at high cost of power and the magnetite and gas filled mazda lamps when the cost of power is low.

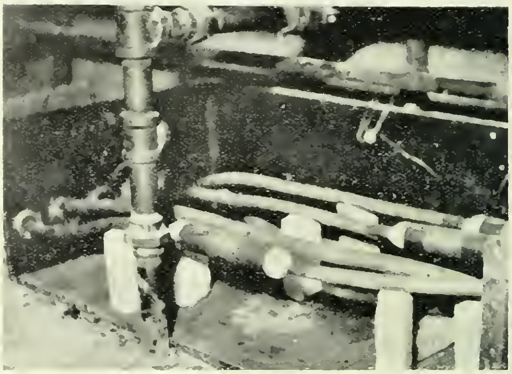
At a recent council meeting a proposal from United Colliery, Limited, controlling 6,000 acres of coal lands near Lake Wabamun, also the Cardiff Colliery of Morinville having an output at the present time of 600 tons daily, offered to supply the city of Edmonton with electrical energy at 3-5 of a cent per kw.h. plus a charge of $12.00 per year per horse power. This, if carried out would mean a saving of several thousand dollars in power bills as at present the power house is charging in the neighbourhood of 2 cents per kw.h. to the Light and Power Department also to the Street Railway Department.

Underground Feeder System—Manitoba Agricultural College, St. Vital

By Mr. R. L. Riggs

The Manitoba Agricultural College at St. Vital—eight miles from Winnipeg—opened in October, 1913. The contract for the underground electrical work was awarded to the Winnipeg Engineering Company, Limited, in September, 1913, and the installation was completed in December.

All the buildings at the college are wired on the three-wire system, single-phase 220/110 volts and all wires are en-

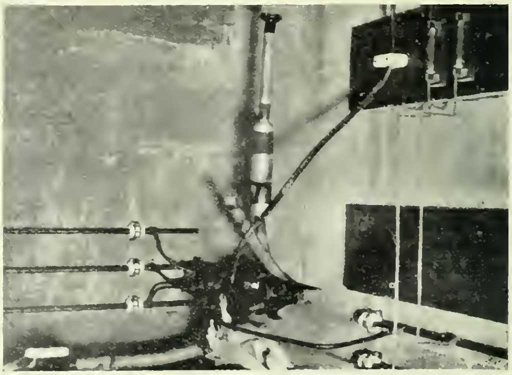


Junction box, showing cable joints.

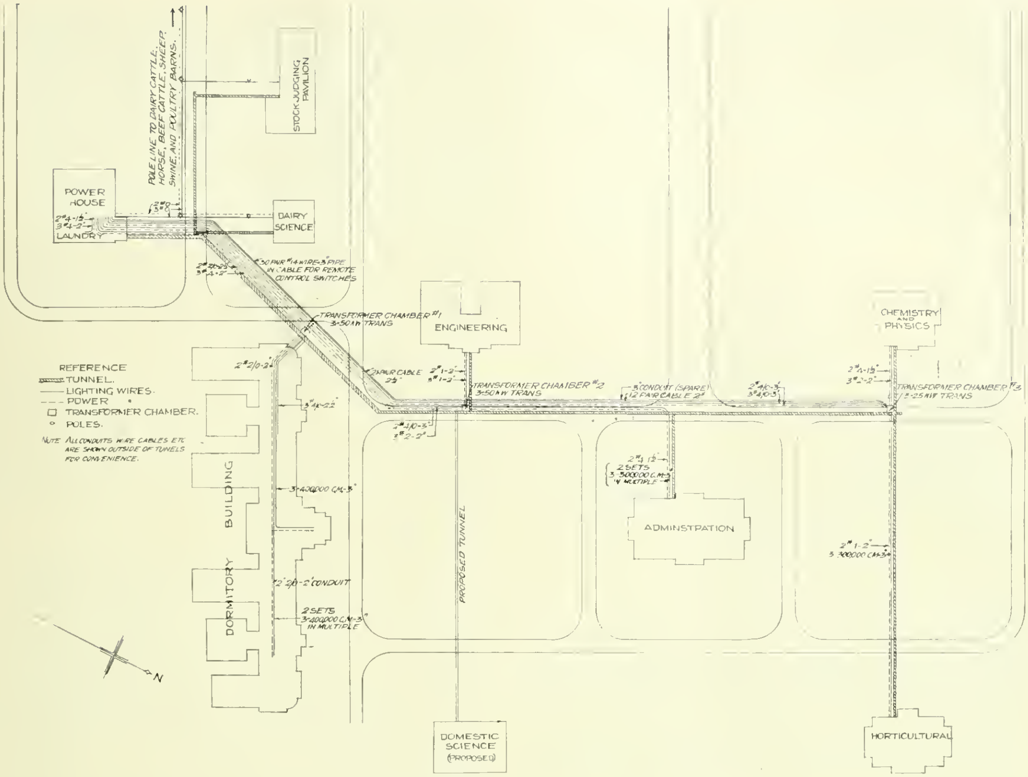
cased in conduit. The buildings also have a 660 volt, power, d.c. service to operate the fans for the ventilating system.

The Provincial Government have signed a contract with the Winnipeg Electric Railway Company for a block of power and the company have built a three-phase transmission line, 22,000 volts, to serve the college and surrounding territory. There are three 600 kw. transformers installed in the high tension sub-station at the college which step the voltage down from 22,000 to 2,200. It is again stepped down at three transformer pockets, provided on the campus, to 220/110 volts before entering the buildings.

An underground tunnel system, built of reinforced concrete, connects the power house with the several buildings. In this tunnel all the high pressure heating mains, water mains, and the electrical feeder system are installed. The feeder cables are lead covered, paper insulated and are carried from the rear of the switchboard to the transformer



Transformer pocket—D.C. and A.C. bus structure.



Plan of buildings showing service wires, tunnels, transformers, puckets, etc.

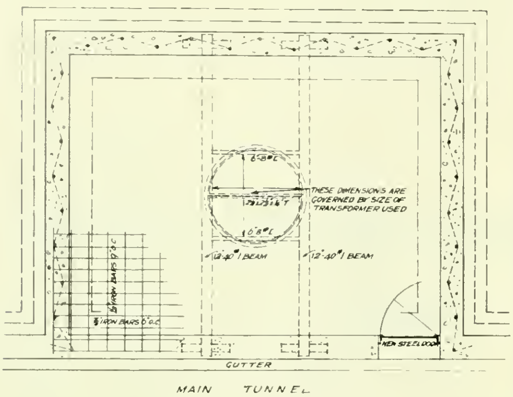
pockets. In transformer pockets No. 1 and 2 there are three 50 kw. single-phase 2,200/220/110 volt transformers, and in No. 3 pocket are three 25 kw. transformers.

Hartman oil switches electrically operated from the power house are provided for each transformer, so that in case of trouble occuring, any one of the buildings can be cut off the system. The pockets are 16 ft. x 12 ft. x 6 ft. 6 in. high and there is ample room provided for additional transformers. Each chamber has an iron door with a ventilator at the top and bottom.

Schedule of Cables

From	Service	Distance	Conduit	Voltage	Lead and Paper
Switchboard to Pocket No. 1	Lighting	410	2"	2200	3 cond. No. 4
Switchboard to Pocket No. 1	Power	410	2½"	600	2 cond. No. 2/0
Switchboard to Pocket No. 2	Lighting	711	2"	2200	3 cond. No. 2
Switchboard to Pocket No. 2	Power	711	3"	600	2 cond. No. 4/0
Switchboard to Pocket No. 3	Lighting	1290	3"	2200	3 cond. No. 4/0
Switchboard to Pocket No. 3	Power	1290	3"	600	2 cond. No. 4/0
Pocket No. 1 to Dormitory	Lighting	300	2½"	220	3 cond. No. 4/0
Pocket No. 1 to Dormitory	Lighting	700	3"	220	3 cond. No. 400000
Pocket No. 1 to Dormitory	Lighting	1000	3"	220	3 cond. No. 400000
Pocket No. 1 to Dormitory	Power	800	2"	600	2 cond. No. 2/0
Pocket No. 1 to Dormitory	Power	1000	2"	600	2 cond. No. 2/0
Pocket No. 2 to Engineering	Lighting	78	2"	220	3 cond. No. 1
Pocket No. 2 to Engineering	Power	78	2"	600	2 cond. No. 1
Pocket No. 2 to Administration	Lighting	425	3"	220	3 cond. No. 300000
Pocket No. 2 to Administration	Power	425	1½"	600	2 cond. No. 4
Pocket No. 3 to Chemistry	Lighting	86	2"	220	3 cond. No. 2
Pocket No. 3 to Chemistry	Power	86	1½"	600	2 cond. No. 4
Pocket No. 3 to Horticultural	Lighting	406	3"	220	3 cond. No. 300000
Pocket No. 3 to Horticultural	Power	406	2"	600	2 cond. No. 1
Control Cable to Pocket No. 1	Oil Sws.	410	3"	110	30 pair No. 141
Control Cable to Pocket No. 2	Oil Sws.	302	2½"	110	21 pair No. 141
Control Cable to Pocket No. 3	Oil Sws.	581	2"	110	12 pair No. 141

The high tension, copper tubing bus bars are mounted on the walls and are supported by clamp insulators manufactured for this purpose. All the connections are made with Dossert connectors. The low tension feeders are lead and paper cables carried in conduit to the entrance cabinets situated in each building. Pot-heads are used wherever the lead cables terminate. In the transformer chambers all the



One of the transformer pockets.

incoming and outgoing cables are also equipped with potheads.

In magnitude this is one of the largest private underground systems in Canada, and the apparatus and fittings are of the latest manufacture.

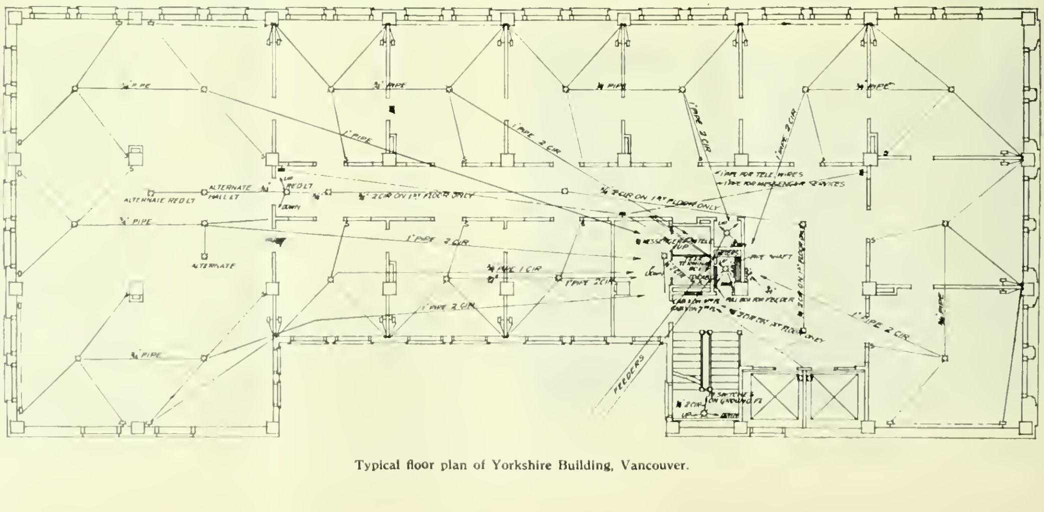
For the purpose of supplying light and power to the sheep, cattle barns, etc., a low tension pole line is built. The poles are cedar—45 foot long, 7 inch tops. The wires are No. 0 weatherproof triple braid. A complete list of cables used in the installation is given in the accompanying table.

The Electrical Equipment of the Yorkshire Building, Vancouver

The most recent example of modern office block construction in Vancouver is the ten-storey Yorkshire Building, an imposing Gothic structure, occupying a site measuring 50 x 120 feet on Seymour Street, near Pender Street, and fitted with electrical equipments of the most modern type. The Yorkshire Guarantee and Securities Corporation, Limited, and the Yorkshire Insurance Company, Limited, the joint owners of the building, occupy the entire ground floor which has been designed for conducting a general banking and trust business, and is treated architecturally in an impressive style conforming with the appearance of the exterior. With the exception of the 8th floor which is occupied by the American Club, the upper storeys are given over entirely to office space, there being eleven single offices and one suite, comprising five offices, on the typical floor. The building throughout is decorated in a most elaborate manner and may aptly be described as one of the most useful and attractive of its type in the province. One-half of the basement has been set apart as rental space while the other half is utilized for the heating plant, consisting of a Webster vacuum system, and the switchboard room.

The B. C. Electric Railway Company supply the light and power which is used in the building and consists of 500 volts d.c., and 220 volts, 3-phase, and 220 and 110 volts single-phase. The 220 and 110 single-phase are used for lighting purposes, while the power supply is being taken care of by the 220 volt, 3-phase exclusive of the current required for two Otis Fensom elevators of one to one traction type which are operated by 500 volts d.c.

The wires for the lighting service consist of three 600,000 c.m. cable and the power service is two 300,000 c.m. cable, the three-phase being made up of three No. 4/0 cable. The switchboard which controls both services was manufactured by A. R. Coutts & Company, Vancouver, and is 6 feet wide and 7 feet in height, with one lighting panel and one power panel of blue Italian marble. All conduits terminate in a steel pull box set in a concrete slab and flush with the ceiling in the basement. From this pull box the wires are carried to the various switches on the board in three steel raceways with removable sides, thus permitting access to any pair of wires at all times. From each of these raceways a conduit is taken to the rear wall on which is mounted four meters, one for the 500 d.c. one for the halls, toilets and public spaces and one for the banking and trust quarters on the ground floor. The method of wiring the various offices on the upper floors provides a circuit to each office, and every circuit is run to a metering panel. The metering panels are set in a closet, specially designed for the electrical equipment, and consist of a slate slab with buzzing



Typical floor plan of Yorkshire Building, Vancouver.

switches and cut outs so arranged that any circuit or combination of circuits on the same floor may be connected on that floor without changing or adding to the original wiring system. The apparatus is arranged in a manner which eliminates the danger of short-circuiting any part of it through mistakes in making connection. The flexibility of the metering system is demonstrated by the fact that any of the different offices may be put on any meter or any number of offices put on the same meter. Provision is made for mounting the meters in a steel cabinet, everything being left in readiness even to the screws which hold each meter in place ready for the wires to be inserted into the conduit terminals. Absolutely no wood is used in the construction of these cabinets.

The cabinet in the Yorkshire Company's offices on the ground floor consists of a double panel of 18 circuits each with flush push switches in the trim. The front of this cabinet is of ⅜-in. cold rolled steel and electroplated in old bronze. The switches on the trim control the massive electroliers of Gothic design in the ceiling of the banking offices.

Every office in the building contains one 3-light ceiling fixture and two wall plugs. The centre lights in each office are controlled by an H. and H. switch with special switch plates to match the trim of the door in which they are placed at a height of 4 feet from the ground. The wall receptacles are of the Bryant screw plug flush type with No. 1709 plates, and all fittings are of bar buff finish except in the Yorkshire Company's own offices where statuary bronze has been used as finish. All the wire used in the building was supplied by the Canadian General Electric Company.

The telephone system consists of a service of 200 pair cable redistributed in the basement and on the 3rd and 7th floors, allowing 15 pairs for each floor. The system is so arranged that one-half of every floor communicates direct with the headquarters of the telephone company while the other half runs to a cross connecting strip box in the basement to permit of the interconnection of telephones throughout.

The electrical equipments of this building were installed by NePage, McKenny & Company, the largest firm of electrical engineers and contractors on the Pacific Coast, under the supervision of Mr. E. G. Mundy the company's local manager.

The Yorkshire Building was erected at a total outlay of approximately $300,000 by the Dominion Construction Company, Vancouver, who completed the general contract at the beginning of March, 1914. Messrs. Somervel & Putnam, Vancouver, were the architects.

The Wahnapitae Power Company, Limited

The Wahnapitae Power Company was organized in 1905 to develop power on the Wahnapitae River, which rises in the Temagami Forest Reserve and empties into the French River. Two power plants were constructed near Sudbury and put in operation with two units each, and it has now been arranged to install a third unit at No. 1 plant to supply the demands for power being made upon the company. This new unit will increase the company's power output by about 50 per cent. In the drainage area contributory to the Wahnapitae River, affording storage facilities, are Wahnapitae Lake, approximately 36 square miles in area, and Welcome Lake, Burwash Lake and Long Lake with an area of approximately 15 square miles.

Plant No. 1 is about 10 miles from Sudbury and has a working head of 52 feet. The machinery consists of one 1250 kw., 2300 volt, 300 r.p.m. C.G.E. alternating generator; one 800 kw., 2300 volt, 300 r.p.m. C.G.E. generator; two exciters direct connected to turbines; one 1800 h.p. Jenckes turbine; one 1550 h.p. Jenckes turbine. The power house is a substantial masonry building with concrete floor and switchboard gallery. Adjoining the power house is a transformer house in which are located the transformers belonging to the Mond Nickel Company and the Moose Mountain Company. Transformers for the current which the Wahnapitae Power Company transmits to Sudbury are also located in this power house. A dwelling for the operators is located on the premises. It is now arranged to add a third unit of 2000 kw. with necessary turbines, switchboard, etc.

Plant No. 2 is situated about 16 miles below plant No. 1 and has a working head of 38 feet. The machinery consists of two 1250 kw., 2300 volt, 257 r.p.m. C.G.E. generators direct connected to two 1800 h.p. Kennedy turbines, and one exciter also direct connected to a turbine. The power house is of concrete construction, 60 x 80 feet, with concrete gallery for lightning arresters and high tension switches, and contains transformers owned by the company for stepping up current for transmission to No. 1 plant, and transformers belonging to the Canadian Exploration Company used for stepping up power purchased by them for transmission to their gold mine 15 miles distant.

The switchboard apparatus in both stations is up-to-date, and all generators are controlled by automatic oil switches. The exciters are fitted with Tirrill regulators and the voltage regulation is excellent, even under very great variation of load. The stations are well kept and the machinery has all been well cared for and is in excellent condition. The only combustible part in either power house is the wood in the roof.

The company sells power wholesale at the power house under contract to the Mond Nickel Company, Limited, the Moose Mountain, Limited, the Dominion Nickel Company, Limited, and the Canadian Exploration Company, Limited, and transmits power at 22,500 volts over its own transmission line 10 miles to its sub-station in the town of Sudbury, Ont., population about 6,500. At Sudbury the company sells current to the municipal corporation for lighting purposes, and also sells power direct to the consumer on its own account, and for this it owns about four miles of distribution lines, 2200 volt two-phase in the town. Existing power contracts amount to 4,468 horse power, and with the proposed extensions it would be possible to sell from 2,000 to 2,500 h.p. over and above the present load and still leave ample margin for good regulation. The present power output is approximately 3,800 horse power. The Mond Nickel Company will take an additional 1,000 h.p. as soon as the company can deliver it, and the power demand in the town of Sudbury is steadily increasing. It is well known that there is no more permanent mining than that of nickel, and the nickel areas of the Sudbury district, in which district the companies taking power from the Wahnapitae Power Company have their properties, are authoritatively stated to be well nigh inexhaustible. It is also well known that the Sudbury district is now producing about 70 per cent. of the world's supply of nickel.

The prices at which the Wahnapitae Power Company is selling power are very much less than power can be produced by steam, as the freight rate on steam coal from Suspension Bridge to Sudbury is $2.60 per ton, making the cost of coal between $5.00 and $6.00 per ton at Sudbury. Prices for power are based upon $14.00 to $16.00 per horse power at the switchboard in the power house (equivalent to about ¼ cent. per kw. hour with a 100 per cent. load factor. The Wahnapitae Power Power Company holds long term leases from the Ontario Government of its water powers on the Wahnapitae River. Both these leases are renewable upon the same terms that they are now held, the rentals being about $1,000 per year each.

The Dealer and Contractor

Steady Advance of Electric Cooking

Electric cooking apparatus for hotels and restaurants, although employed for the past few years in Europe, and particularly in England, has only recently received favorable consideration on this side of the water. It has, however, now become apparent to all who have looked into the question that for many cooking operations this method has numerous advantages over the use of coal or gas. And progressive chefs and their managers—if they expect to be truly up-to-date—cannot afford to overlook or ignore the issues raised by the perfection of electric cooking apparatus. Electric apparatus is particularly well adapted to high temperature operations such as broiling, frying, roasting, baking, etc., all of which are accomplished rapidly and with more ease and comfort than is possible with the old methods. Considerable floor space can also be saved by its installation. The problem of storing and handling coal is eliminated, as well as such objectionable features as smoke, gas and excess heat.

A recent large installation of much interest has been made by the Canadian General Electric Company for the King George Hospital, Winnipeg, as shown in this illustration, and a short description of the equipment will be of general interest.

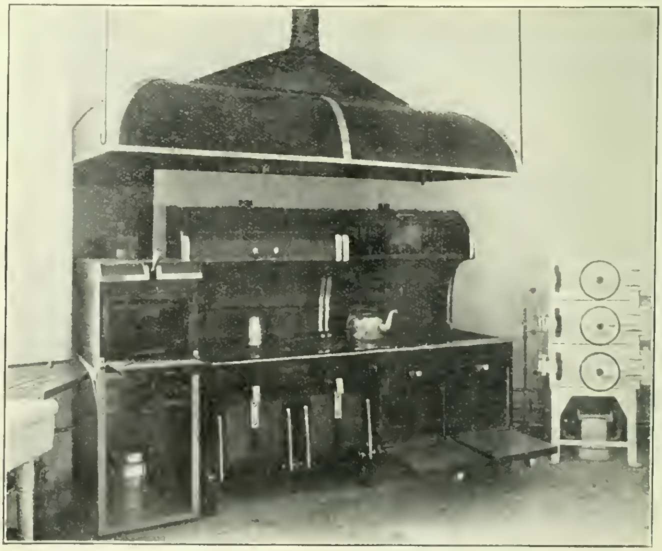
The installation consists of two electric range units and one broiling unit and has sufficient capacity to take care of 250 persons. Each range section comprises two roasting ovens and a top cooking surface divided into eight rectangular hot plates. The overall dimensions of one section of the range are, 44-in wide, 38-in. deep, 68-in. high (to top of switch box). The cooking surface is 33-in. above the floor. Each of the two roasting ovens in one section of the range is 18-in. wide, 28-in. deep and 16-in. high inside diameter. Each oven is arranged for two heats, the top and bottom units being separately controlled. The maximum consumption for each over is 4,800 watts.

The top cooking surface of one section of the range is 36-in. wide x 24-in. deep and consists of eight rectangular hot plates, each 9-in. x 12-in. These hot plates are controlled by separate switches, the four in front consuming 1,600 watts each, and the four in the back 800 watts each. The object of this arrangement of heat for the hot plates is to conform with conditions obtained on the coal burning hotel range. The four plates in front operate at a high temperature, and the kettles are first placed on these high temperature plates and brought to the proper cooking temperature. The kettles are then pushed back to the plates in the rear, which consume just one-half of the energy but will maintain the desired cooking temperature as long as required. This gives a very simple arrangement, but will amply provide for all requirements, and, as stated above, conforms with the conditions on a coal range, in which case one end is maintained at higher temperature and the other end at a lower temperature.

The controlling switches, as used on this range, are lever knife switches and are mounted on a slate panel above and at the back of the range. This panel is enclosed by means of a roll top door. The control switches are arranged in one row and a nameplate is placed over each switch to show what part of the range is controlled by that switch. A circuit breaker is mounted in the center of the panel and controls the main circuit of the range. In addition to this there are small cartridge fuses on the oven and hot plate circuits.

The walls of the ovens are all double and filled with navy fire felt, an insulating compound which will always retain its shape because it is moulded. The front of the range is of heavy steel plate. The ends of the range are of blued steel, and the back is of heavy galvanized iron. All the interior walls are of sheet steel.

An important feature of this range is that the hot plates on top are mounted in pairs on a casting which is hinged at the back. Each pair consists of one front and one rear hot plate. The entire space beneath the eight hot plates is taken



Electric Cooking Equipmentin King George Hospital, Winnipeg.

up by one large scavenger pan. Thus the hot plates can be raised up in pairs and the scavenger pan below thoroughly cleaned out. This construction permits keeping the range in perfectly sanitary condition at all times.

The hotel broiler, as supplied with this range equipment has overall dimensions 23-in. wide, 41-in. deep. The active broiling area is 14-in. x 20-in. or 280 sq. inches, and is sufficient for broiling at one time about 12 lbs. of steak or chops having a thickness of 1½-in. If the weight of the average steak be taken as two pounds, the hotel broiler may be considered as having a capacity of five or six steaks at once, and as ten minutes is required for broiling, it is possible to broil about 36 steaks, or 70 pounds of meat per hour.

The radiant heating unit is located at the top of the broiler chamber and is controlled by a DP spring knife switch mounted on the back of the broiler but operated from the front. The unit is divided into two windings; the main winding consumes 4,500 watts and is used only when actually broiling; the auxiliary winding consumes 500 watts and is used for keeping the broiler hot between broiling operations. The gridiron, on which the meats rest, is supported below the unit on a movable frame, raised or lowered by a lever. The gridiron can also be drawn out for turning or removing the meats. A drip pan rests on the bottom of the broiler chamber.

Electrical Apparatus Co., Limited

One of the few modern electrical manufacturing firms which has works situated almost in the heart of London, Eng., is the Electrical Apparatus Company, Limited. This progressive company's manufactures comprise mainly motor control and switchgear and house service meters, of which latter they have just introduced a new type for a.c. services. The company commenced its career in 1907, its object being to supply gear of the above order which should be in advance of that then generally used, while at the same time, by the application of experience gained by the directors in America and the Continent as well as in England, the cost should be kept at a low figure. The premises in which manufacture was commenced soon had to be enlarged, and later, further extensions being impracticable, a new works was erected in Vauxhall on part of a site purchased by the company. This building was of a modern design, the works and offices all being on one floor, but within two years, the business had again outgrown its accommodation, and a floor was added to the offices, and a two-storey building was erected on the remainder of the site.

That the company was justified in its foundation is proved by the fact that although the volume of business which necessitated these expansions had to be obtained at competitive prices, the standardization of apparatus manufactured rendered it possible to make a substantial profit each year, and the financial expansion of the company has kept pace with the industrial, for twice within the last year extension of capital has been deemed advisable—at the latest of these in July, 1913, a new company—the Electrical Apparatus Company, Limited, was formed, the capital being raised from £30,000 to £90,000.

The company's apparatus is well known throughout Great Britain, and is steadily gaining a reputation in the colonies, especially in Canada, to which a considerable quantity is already exported. Not content with this, however, the company, which is already represented in every part of England, has decided to open a Canadian branch office in Toronto in the course of the next few months, in the hope that they may help to swell the volume of trade between the two countries, and to obtain their share in the expansion of Canadian electrical business.

The greater part of the gear manufactured is of more or less standard design, but there are many useful and ingenious improvements. The illustration, Fig. 1, shows what is possibly one of the neatest of these—the slow-motion attachment to the one minute type starters. The slow-motion is attained by a pawl carried on the lever, moving in a guideway provided with alternate camming and arresting shoulders. By this means a swift movement from one contact to another is obtained, while a definite stop on the centre of such contact is assured. The backward motion of the arm is not in any way impeded, and even the least skilled and most careless operator can hardly fail to obtain a satisfactory start. This same device is employed in the star-delta and auto-transformer starters to prevent the operator passing from the "off" to the running positions without resting at the starting position.

It is of interest to note that these starters are one of the few types made in England which are in accordance with Canadian regulations. All the oil-immersed switchgear

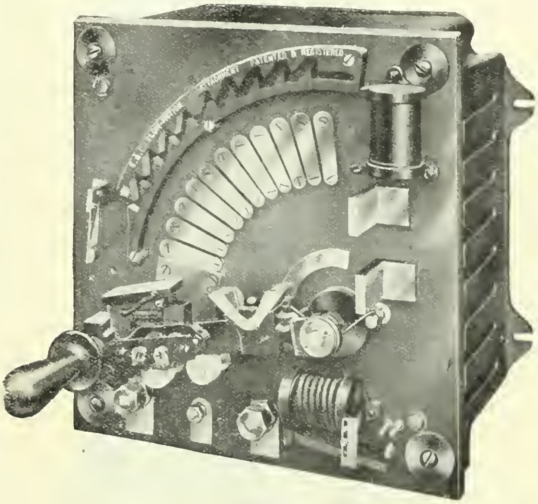


Fig. 1

is of the drum type, of extremely solid construction, and a patent self-aligning finger which is shown, ensures that perfect contact is made by each finger. In addition to this, the drum is turned up in the lathe, and the fingers, after being assembled, are ground to shape by a drum of the correct size covered with emery cloth. It is to the extreme care taken in these small details that the high reputation which the company enjoys is due.

Of a number of interesting designs, one of the most unusual is the Multiple Lever Automatic Starter, Fig. 2. As can be seen from the illustration this is a very simple piece of apparatus. There is only one solenoid, which pulls up a horizontal bar extending across the width of the starter against a dash pot. Each step on the starter is provided with a separate knife switch, each switch being raised slightly above the last. In this way the bar engages with each blade in succession, closing it slowly until the two springs with which each blade is provided come into operation and close the switch with a decisive snap.

A point of interest in the a.c. gear is the no volt release, of which the magnet core consists of a heavy piece of laminated iron, detached from the lever which catches with the switch handle. In this way a decisive blow to the lever is assured from the impact of several ounces of iron falling through nearly ¼ inch—and the operation is certain. It is

also worth noting that the motion of the lever in the squirrel cage motor starters is continuous in one direction, a much more satisfactory arrangement than the reversal of direction so common in these starters.

To turn to meters, the B.A.C. high torque continuous current meter is already well known. It is an ampere-hour commutator meter particularly adapted for use with small consumers, for owing to the high torque provided, reliable and accurate readings are obtained even with only one lamp in circuit. Both the commutator and the brushes are 18 carat gold, and oxidation or other alteration of the commutator surface is eliminated, while the insulation throughout is of mica with the exception of an ebonite sleeve under the commutator segments.

The a.c. meter, which has recently been designed, has, like the d.c. meter, a very high torque—9 cm.gr.—while the

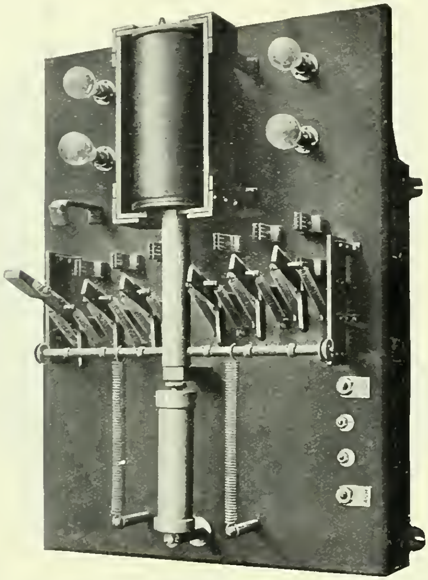


Fig. 2

shunt losses are exceptionally low. For instance, tests show a variation of less than 2½ per cent. in accuracy between 25 and 50 cycles, and between 100 and 200 volts. Not only is this meter carefully designed from the point of view of accuracy but details of mechanical construction have had careful attention. For instance, by the removal of four easily accessible screws, the whole of the moving element and dials are removed, and can be attended to, at the same time leaving the coils and the magnetic circuits exposed for attention. By replacing the moving element upside down relative to the case, and securing with the same four screws in the same position, the meter can be used as for top terminal instead of for bottom terminal connection.

All of the gear and meters manufactured are very carefully and thoroughly tested both during manufacture and on completion, and so far as is practicable, everything is made on the works, even to the cutting of the gear wheels on the meters.

Mr. Howard Murray, vice-president of the Shawinigan Water and Power Company, has promised to provide for a number of years two McGill scholarships in history of $100 each, to be awarded on the same conditions as the MacKenzie scholarships in economics.

A New Electrolytic Lightning Arrester

For the protection of cable systems, motors and generators connected directly on a line without transformers, or transformers with weak insulation on their end turns, the Westinghouse Electric & Manufacturing Company has recently introduced a lightning arrester, known as the Type AK, with a charge-and-discharge resistor in series with the standard electrolytic element. This resistor serves to limit the charging current to a low value and to damp out any surges that might result in charging, particularly if the system contains enough capacity to produce resonance. The arrester is made for use on circuits up to 14,500 volts.

The electrolytic element consists of treated aluminium trays stacked one on another, separated and insulated from

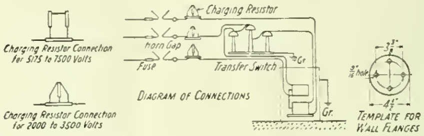
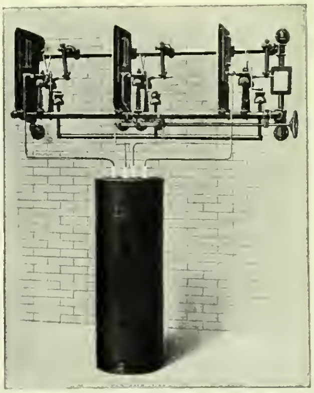


Diagram of connections, new arrester.

each other by porcelain spacers on the periphery of the trays; the number of trays in a stack depending upon the normal voltage of the line on which the arrester is to be used. The stacks of trays are suitably supported in frames, and each tray is filled with electrolyte. The stacks are then arranged in welded steel tanks and immersed in oil.

In actual operation, a film of the electrolyte forms on the surface of each tray. This film has a high resistance at normal voltages, but the resistance becomes very low at abnormal voltages. It therefore forms a free path for abnormal voltages or static charges, but upon cessation of the abnormal stress the film instantly regains its high resistance.

The arrangement of the trays and the electrolyte is such that the electrolytic element acts as an electrostatic condenser. The flow of current, due to the capacity of this con-



New type lightning arrester.

denser, varies inversely as the frequency of the circuit. Thus, at normal commercial frequencies, the flow of current is small, but at the high frequencies of lightning discharges and static disturbances, considerable current flows through the element, increasing the action of discharging the static charges and preventing flow of current at normal frequency.

When an electrolytic arrester is being charged, surging currents are set up in the system. Under most conditions these are harmless, due to insulation of the apparatus connected in the same circuit. However, as above noted, there are cases in which these surges are dangerous and in order to

remedy this danger the graphite resistor is used to damp out the surges and limit the charging current to a low and safe value.

This resistor is connected in series between the horn gap and the arrester in each phase. It is shunted, however, by a series of non-arcing metal spark gaps which are auxiliary to the main horn gap. In the operation of charging the horn gap is short-circuited, as usual, and at the normal voltage of the circuit the charging account takes the resistance path rather than the shunt auxiliary gap path. On the occasion of a discharge due to lightning or static disturbances the auxiliary spark gap path is easily broken down, and the discharge passes through same rather than through the resistor, thereby assuring precisely the same freedom of discharge as in the case of an arrester which does not use the charging resistor. Upon the circuit being restored to normal voltage and frequency after the discharge the auxiliary spark gaps cannot maintain the circuit and it is shunted to the resistance path. This action is very materially helped by the use of multiple gaps between non-arcing metal. The resistor limits the amount of dynamic current flowing, and thus helps in the final action of opening the circuit by the rise and final break of the arc on the horn gap.

On each occasion of charging ungrounded neutral arresters to rebuild these films, after once bridging the horn gaps, the leads connecting the two middle legs to the ground and to the center fuse, respectively, should be interchanged and the gaps again bridged; thus serving to charge all the "legs" of the arrester. To facilitate this charge, a transfer switch is provided as shown in the illustration. A handwheel is geared to this transfer switch in such a way that the switch can be reversed without the operator in any way coming in contact with live parts, the frame of the arrester being grounded.

Multi-Circuit Totalizing Graphic Recorder

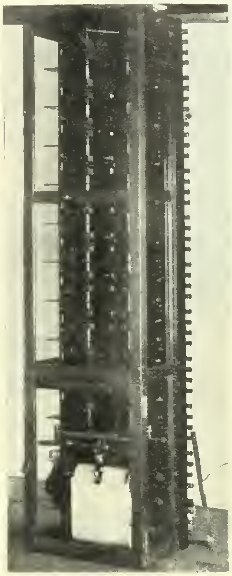
The accompanying photograph shows an eleven element Graphic Totalizer, which is probably the largest electrical graphic recorder ever built, not, perhaps, in point of size, but in capacity. This meter was built for 110,000 kilowatt service, full scale reading, and is to totalize the wattage of eleven separate polyphase circuits simultaneously.

These meters act on the principle of the true Kelvin balance: namely, the balancing of an electrical force against a travelling weight on a scale beam, and not against some form of spring, as in most other types of Graphic Recorders. The travelling weight is moved along its ways by means of a drag link attached to the control system, which operates the pen mechanism. The control system consists of two solenoids with plungers attached to control the arm, which in turn, moves the pen along its ways. These solenoids are energized through contacts carried on one end of the measuring element, but in no way interconnected with the measuring system. Thus, a source of power is supplied from a separate circuit to move the pen and weight without in any way affecting the measuring element.

From the bottom measuring element downwards, the mechanism is simply that of a standard meter, with the exception of two small steel cups located in the balancing element, in the center of the potential coil. Standing in these cups on steel points are two brass rods which run vertically the full length of the meter, and carry the potential coils of each measuring element. Thus the forces of each and every measuring element which is alive, are communicated directly to the bottom measuring element, and scale beam, where their sum is weighed by the gravity system. The upper ends carry small steel cups and the bed plate to the rear of each rod has two stationary cups. Two triangular brass plates with steel points at each corner are then placed so that two points rest in the bed plate cups and one in the cup on the top of the rod. This provides a perfectly frictionless support for the top of the rods and allows them to move up and down when the element is balancing. As this is a zero reading instrument, this balancing motion is not over 1/100 of an inch.

The elements are astatically wound to eliminate the effect of stray fields and heavy iron baffle plates are placed between elements which completely eliminates the magnetic effect of one element or another.

The sensitiveness of these meters is equal to, if not superior to that of any graphic meter we know, the extreme



Multi-circuit Totalizing Graphic Recorder.

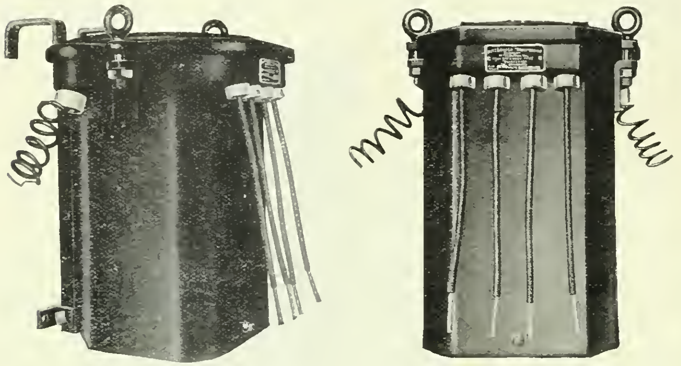
weight of the measuring element in no way impairing its sensitiveness. These meters are so accurate that they can be guaranteed to within one-half of one per cent., full scale reading at all points of the scale. On test, they have always shown themselves accurate to within one-tenth of one per cent., and, due to the gravity principle, the scale is always perfectly proportional. This metre is manufactured by Staebler & Baker, Gananoque, Ont.

Pressed Steel Transformer Case

A new and radically different type of transformer case for distributing transformers has been developed, illustrations of which are herewith shown. This new case is of pressed-steel, replacing the ordinary cast-iron cases which have been in general use for the past twenty-five years. The material used is blue-annealed planished steel plate. The principal advance in design claimed for the new pressed-steel case is, that it is much lighter and stronger than the ordinary cast-iron cases. The reduction in weight of transformers is important to the Central Station, because the cost of handling transformers is a definite appreciable item of expense to which little attention has been paid heretofore, probably because there was no escape from the bulk and weight of distributing transformers, since all manufacturers have been confined to the use of heavy cast-iron cases.

Transformers are really a tonnage material when considering the handling expense, the lightest and smallest size

weighing at least 100 lbs., and the medium and larger sizes weighing up to 3,000 lbs. each, for the pole type sizes. The handling of distributing transformers is necessarily done by the line-crew with "hand-power" and "man-power," which is higher in cost than "horse-power." Saving in the cost of freight is easily seen because it can be definitely shown by figures. An average saving to the total transformer weight of 30 per cent. claimed by the manufacturers of the new



Light weight pressed steel transformer cases.

pressed-steel case transformers, means practically an average saving of 30 per cent. in freight. While it is difficult to get accurate Central Station costs for the handling of such heavy material as transformers, fairly close estimates are made and such estimates show that on 10,000 lbs. of transformers shipped 500 miles, the freight, cartage, loading, unloading, warehousing, installing, etc., costs about $110. Thus, a 30 per cent. decrease in weight saves $33.

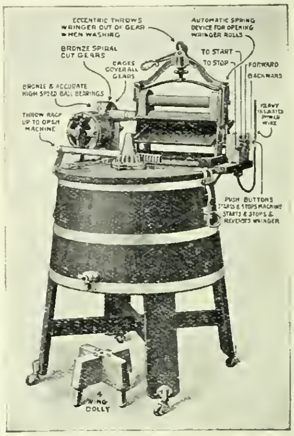
The percentage of weight reduction (30 per cent.) is substantial enough to result in other practical benefits to the Central Station in permitting larger transformers to be mounted on poles with the same pole-strain safety factor, or permits the use of smaller poles for given transformer sizes. Reduction in weight with the additional advantage of strength is, of course, very desirable. It is claimed that the new pressed-steel case has been developed not only lighter in weight, but much stronger than cast-iron, so that the new case will stand up even better to the every day wear and tear, rough handling in transit, accidental bumps and jars, such as sometimes hapepns when a transformer is dropped from a pole or wagon.

Tests were made by a prominent laboratory, it is stated, where thirteen blows with a sledge failed to show any injury, except slight indentation of the pressed-steel, whereas, two blows of the sledge applied to an ordinary cast-iron case cracked the cast-iron case with the first blow and completely shattered it with the second blow. The common cast-iron case will leak oil, due to seepage through the porous cast-iron unless it is carefully Japaned, and where the cast-iron is imperfect or thin, hot transformer oil will seep through the metal and drip. Pressed-steel, due to its density, and nonporous structure, eliminates the possibility of oil seepage. The new pressed-steel case has been under development for several years and it is stated actual tests in service have been thoroughly carried out by its originators, the Pittsburgh Transformer Company, Pittsburgh, Pa.

The town of Leduc have asked a local firm of consulting engineers to proceed with the plans and specifications for a municipal electric light plant, when the necessary by-laws will be submitted for the approval of the ratepayers.

The " Electric Lady" Washer

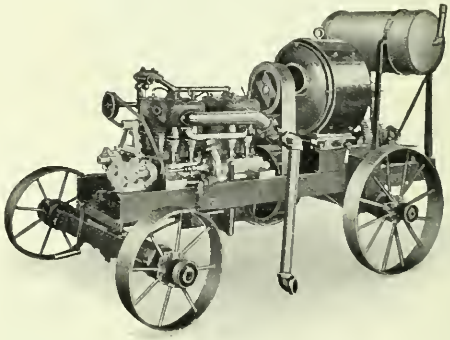
The "Electric Lady" washer is a new machine which is just being placed on the market by the Michigan Washing Machine Company, Muskegon, Mich. This machine has been carefully designed to include the very latest electrical and mechanical features; for example, the whole machine is controlled by push buttons. All moving parts are fully protected and an automatic electric wringer release insures absolute



safety to the operator's hands. Ball bearings are used where the greatest strain occurs and bronze bearings in other places. As quiet operation was considered essential, all moving parts are carefully designed to run quietly and the materials are so selected that the wear is small. Adjustment is also provided for wear. A Westinghouse Electric small motor furnishes the power.

Illuminating Amusement Devices

The illustration shows a portable generating equipment made up by C. W. Parker, manufacturer of amusement devices of all kinds. The outfit consists of a "Standard" 115 volt, compound-wound, direct current generator, made by the Robbins & Myers Company, Springfield, Ohio, mounted with a gasoline engine on a steel frame truck. The en-

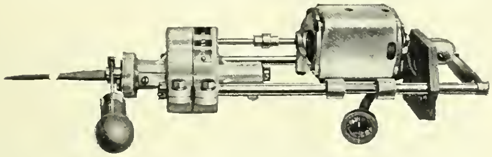


gine is of the automobile type and is connected to the generator by a short belt with idler pulley attachment.

To meet the requirements of the various devices with which these generating outfits are used, four sizes are made, using Robbins & Myers generators of 2, 3, 5, 7½ and 10 kw. capacity.

A New Electric Drill

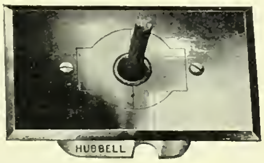
The cut herewith represents an electric drill manufactured and sold by the Electric Tachometer Company, Philadelphia, and sold in Canada by R. E. T. Pringle, Toronto. The "Locke Electric Drill" is made in two sizes, requiring 1/16 and 1/8 h.p. A universal motor is used. The "Locke Electric Drill" is designed for drilling holes in concrete floors for carpet sockets; in bathroom tiling for attaching fixtures; drilling holes for attaching fire extinguishers, securiny theatre seats, attaching window awnings, fire escapes, iron railings, mounting signs; cutting holes in concrete by



drilling a series of small holes and breaking out the solid part by the plug and feather system; drilling holes in partitions for electric wires or conduits, steam and water pipes; drilling and chipping square holes in marble panel work for electric fixtures; drilling holes for attaching racks for telephone or signal wires to stone or concrete abutments of railroad bridges or retaining walls; for drilling holes in concrete floors for mounting machinery; and for a variety of other purposes.

New Hubbell Receptacle

The cut herewith represents a new flush receptacle just placed on the market by the Harvey-Hubbell Inc., Bridgeport. This new device presents an absolutely flush surface when the device is in use as well as when the cap is removed. The cap is also very small and much neater in appearance



than those interchangeable with the general line of receptacles corresponding to the regular types manufactured by this company. These new types have also concealed contacts insuring freedom from short circuits and shock.

Developing Fan Sales

The Robbins & Myers Company are distributing a folder to electrical dealers and contractors in which they offer assistance in developing fan sales. One of the methods of assistance is by supplying local papers with cuts showing the advantage and comfort following the use of electric fans.

New Companies

The Electric Furnace Products Company, Limited, has been incorporated with capital $5,000,000 and head office Toronto. The company is given power to build and operate electric plants manufacturing calcium carbide and allied products in Canada and Norway.

It is said that work on the electrification of the Kerr Lake branch of the T. & N. O. Railway will be commenced early in May. This will be operated as part of the present Nipissing Central system.

Personal

Mr. A. F. Moray is leaving the Shawinigan Water and Power Company to take up construction work with the Cedars Rapids Manufacturing & Power Company, Cedars, Que.

Mr. E. I. Sifton has been appointed the first general manager of the Hamilton hydro-electric system. Mr. Sifton has been in charge of the construction work on the Hamilton system as chief engineer since its beginning.

Mr. G. F. Drewry, B.Sc., has just joined the Toronto section of the Ferranti Electrical Company as general sales engineer, his particular function being to assist in the development of the business of this firm in connection with their representation of Messrs. Bruce Peebles. Mr. Drewry was previously district manger in Winnipeg for the Allis-Chalmers-Bullock Company and more recently was sales engineer for the Canadian Allis-Chalmers, Limited.

Trade Publications

Coal Conservation.—A report on "Conservation of coal in Canada" compiled by W. J. Dick, Mining Engineer of the Commission of Conservation.

Unilets.—The Appleton Electric Company of Chicago have just issued a very complete catalogue illustrating and describing their line of unilets and conduit fittings.

Small D.C. Generators.—Bulletin No. A4188, issued by the Canadian General Electric Company, describing and illustrating their small belted type direct current generators.

Starting Switches.—Bulletin B531, February, 1914, issued by the Allen-Bradley Company, Milwaukee, describing their type G. starting switch for small induction motors which do not require a starting resistance to limit the current.

Electrical Specialties. Catalogue 15, issued by Harvey Hubbell, Inc., Bridgeport, Conn., describing the Hubbell electrical specialties; one of the most complete catalogues ever issued on this subject. It contains 175 pages of well-illustrated descriptive matter.

Stream Measurements.—Report of progress of stream measurements for the calendar year 1912, just issued by the Department of the Interior for the Dominion of Canada. This report has been prepared under the direction of F. H. Peters, C.E., Commissioner of Irrigation by P. M. Saunders, A. M. Can. Soc. C. E., chief hydrographer.

Link-Belt Silent Chain.—Data book No. 125, issued by the Link-Belt Company, Chicago, giving complete engineering information on silent chain drive in a simple and compact form. This data book describes many different uses of silent chains for the efficient transmission of power and gives specific reasons and illustrations showing its application in a large variety of uses. The book is claimed to be the only work of its kind.

Telephone Report—A report issued by the Department of Telephones of the Province of Saskatchewan covering the financial year ending February 28, 1913. Subscribers to the government system have increased during the past year by about 5,000, bringing the total number served to almost 15,000. The system now comprises 3,172 pole miles and 11,857 wire miles of long distance telephones. To the 15,000 subscribers served by the government system may be added some 9,000 being served through rural, municipal and private systems representing a total of 24,000 telephone subscribers within the province. There are 187 rural companies connected up with the government exchanges. The number of incorporated independent telephone companies in this province is 25, municipal telephones 5, and rural telephone companies 337.

Current News and Notes

Beloeil, Que.

Armours, Limited, Montreal, have secured a contract for a domestic and street lighting and power system at Beloeil, P.Q. The Southern Canada Power Company are building a transmission line from Richelieu to the outskirts of Beloeil, and the municipality will continue this line through the town, a distance of five miles. The power, supplied by the Montreal Light, Heat and Power Company on the 50,000 volt transmission line, will be stepped down to 2,300 volt in a small transformer station at the town line, which will be carried on cedar poles 30 feet high and erected 42 per mile. The street lights will be 100-80 c.p. mazda series lamps, connected by goose-neck brackets and fitted with corrugated metal reflectors. For the street lighting, there will be a 10 kw. transformer, and for the domestic service two 20 kw., one 15 kw., and twelve 7½ kw. transformers. On the primary line No. 4 double braid weather-proof wire will be used, and for the secondary lighting and series No. 6 will be employed.

Chatham, Ont.

Negotiations are still proceeding between the Chatham Gas Company and the Hydro-electric Power Commission for the purchase of the plant of the former for the sum of $410,000 plus the cost of extensions since the date of the commencement of negotiations. According to a reported statement of Mr. P. S. Coate, manager of the company, the only point at issue now is some $25,000 for supplies on hand. If negotiations fall through the Commission recommend the erection of a municipal distributing system at a cost of some $90,000. It is to be hoped the sum of $25,000 will not stand in the way of an amicable arrangement for the purchase of this system in view of the unsatisfactory results which have followed the duplication of systems in the towns and cities where the private plants were not purchased.

Chandler, Que.

The Parsons Pulp & Lumber Company are installing 27 induction motors throughout the different departments of their pulp mill at Chandler, Que. These motors are being supplied by the Canadian Crocker-Wheeler Company. Our item in reference to this plant which appeared in the April 15 issue would make it appear that this equipment was supplied by another company.

Calgary, Alta.

A by-law will be submitted on April 30th authorizing the expenditure of $300,000 on electric light extensions.

Edmonton, Alta.

A by-law has been passed authorizing the expenditure of $168,000 on street railway extensions.

Embro, Ont.

On April 24 the ratepayers voted on a by-law authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario.

Fort William, Ont.

The committee appointed to investigate the matter have reported on the advisability of Fort William's purchasing their power from the Kaministiquia Power Company at 22,000 volts. This will necessitate the erection of a step-down station and the purchase and installation of transforming equipment.

Property owners on Arthur street, between Franklin street and the western limits of the city are working on a scheme for an extension of the street railway from Franklin street west to the western limits of our city. It is proposed to construct the road by private subscriptions, and when completed to turn it over to the city, free of encumbrances, for operation.

Hamilton, Ont.

It is reported that Engineer Sifton's estimate on the cost of installing a lighting system on certain sections of the mountain has been approved.

London, Ont.

The request of the London, Grand Bend and Stratford Railway Company for permission to operate their cars over the tracks of the London Street Railway was refused by the Railway Committee of the provincial legislature.

Montreal, Que.

The Southern Canada Power Company, Limited, are constructing a 50,000 volt transmission line from Richelieu to Sherbrooke. At present the line will be built to St. Hyacinthe, but it is planned to eventually continue it to Drummondville and to Sherbrooke. The company recently acquired the plants and properties of the South Shore Power Company, the St. Hyacinthe Gas and Electric Company, and the St. Johns Electric Company, and also control three water powers on the St. Francis River near Drummondville, capable of developing 30,000 horse power. The idea is to eventually link up these various plants, and to form the now scattered units into a complete system for supplying light and power. The lines will be carried mainly on cedar poles, about 35 feet high, but it will be necessary to construct steel towers 135 feet high where rivers have to be crossed. Part of the power is to be supplied for the present by the Montreal Light, Heat and Power Company. J. M. Robertson, Limited, Montreal, are the consulting engineers.

At the annual meeting of the Maritime, Coal, Railway and Power Company, held in Montreal, on April 18, it was announced that the net profits were $116,000, a gain of 16 per cent. It is proposed to increase the output of the colleries, and with this view six new electric coal cutters have been purchased and three intsalled. During the past year the plant for supplying electric power at Amherst, N.S., has been doubled.

There was a large attendance of the members of the Montreal Electrical Society at the second annual dinner, held at the Commercial Travellers' Club, Read Building, on April 15. Mr. T. H. Nicholson presided. The toast list was limited to four toasts. "The Society" was proposed by Professor A. M. Gray, of McGill University, who referred to the part engineers played in developing the wealth of the country, and to the experimental work which is being carried out by Canadian electrical engineers. Canadian engineers were now coming into competition with men from other countries who perhaps had a better training than those in this country, and he urged the absolute necessity of technical education in order that Canadians should keep their positions in the electrical world. They had to rely to a certain extent on text books from Great Britain and Europe, which in some respects were not quite suitable to our conditions, and Professor Gray instanced the prominence given to the study of direct current in Europe and the great use of alternating current in Canada. Mr. P. T. Davies replied, and referred to the

combination in the society of social intercourse and technical lectures. In proposing "The Executive," Mr. T. R. Campbell stated that they represented every branch of the electrical industry. Mr. W. H. Winter responded and appealed for a closer co-operation between the members and the officers. "Our Guests," proposed by Mr. J. N. Mochon, was replied to by Mr. F. C. Burnett, who declared that the old idea of keeping knowledge to oneself had died, and that the practice to-day was along the lines of co-operation.

Earnings of the Shawinigan Water and Power Company for March were $141,815, the largest monthly total in the history of the company. This figure compares with $133,240 in March, 1913, an increase of $8,575.

Mr. J. M. Forbes, of Forbes & McCormick, Montreal, has been engaged by the Quebec Railway, Light, Heat and Power Company to carry out work to remedy certain defects in the general system reported on by Mr. James Bennett of Montreal, by authority of the Quebec Public Utilities Commission. Mr. Forbes and Mr. Bennett have visited Quebec for the purpose of supervising the work which was ordered to be done by the Commission.

The proprietors of the city of Westmount, P.Q., having passed the necessary by-law, the Council are proceeding with the extension of an improved lighting system. A sum of $8,000 has been voted for additional 6.6 ampere magnetite arc lamps and for standards. A sum of $10,000 will also be provided for laying underground conduits, the work to be done by day labor.

The Cedars Rapids Manufacturing and Power Company have let the contract for a 66,000 volt transmission line, which will run from the plant to the step-down station at Cote St. Paul, a suburb of Montreal, a distance of about 30 miles. The Canadian Allis-Chalmers, Limited, will supply the steel poles, which will be lattice type, 40 feet high. The wires will be aluminum, steel reinforced, manufactured by the Northern Aluminum Company, Shawinigan Falls.

Ottawa, Ont.

The W. C. Edwards Lumber Company have been temporarily refused an extension of their charter which would allow them to generate and sell electric power. It is feared that the company's operations might interfere with the work of the Ontario Hydro-electric Power Commission in Eastern Ontario.

Outremont, Que.

On the recommendation of Dr. L. A. Herdt, their consulting electrical engineer, the Outremont Council have accepted the tender of the William Hamilton Company, Limited, Peterboro, for electric light standards to be used in connection with a new system of street lighting. The company will supply 12 large combined lighting and trolley standards and 375 small standards for the side streets.

Owen Sound, Ont.

There is some talk of an electric railway in Owen Sound. A twenty-five year franchise is being asked by a private syndicate.

Prince Rupert, Sask.

Tenders have been received for the equipment necessary for the initial development of hydro-electric energy for the city of Prince Rupert.

Portage La Prairie, Man.

The special power committee recently appointed by the city council have made a preliminary report on the hydro-electric power possibilities for Portage La Prairie. They recommended that they be given further authority to confer with an engineer of experience and integrity to verify figures already in hand. It is considered possible that the city of Brandon may co-operate in the joint ownership of a transmission line from Winnipeg.

Regina, Sask.

The city of Regina has decided to purchase four new street cars. A considerable reduction in power rates will probably go into force in Regina within the near future, the civic utilities committee having decided to grant various concessions in the interests of the power user.

The operating returns for the municipal street railway system, Regina, for the week ending April 4th are as follows: revenue $4,094.85; passengers carried 95,436; passengers carried including transfers, 106,520. The corresponding figures for the week ending April 11th are as follows: $3,776.20, 92,-251 and 103,468.

Thorold, Ont.

The town council have passed a by-law granting a right of way to the St. Catharines, Merriton & Thorold Electric Railway, into the factory district.

Toefield, Alta.

The people of Toefield are agitating for a municipal light plant, but owing to the financial condition of the town they have not yet been able to start the undertaking.

Toronto, Ont.

The estimates for the year include the providing of sufficient capital to add some 8,000 new lamps to the street illumination system.

The provincial estimates include an item of approximately $5,000,000 for extensions to the Ontario Hydro-electric system. The principal items are as follows:—Niagara system extensions, $3,421,786; Severn system, $550,000; Wasdell's Falls, $191,751; St. Lawrence system, $22,680; Port Arthur system, $20,513; Eugenia Falls system, Grey county, $250,000; Office building, $150,000; estimates on account of provincial work, $165,000.

The Hon. Adam Beck has introduced a new hydro-radial bill in the local legislature. The new bill repeals the legislation of last session and provides for the financing and operation of radials on an entirely new basis. Instead of the money being raised by municipalities through the sale of their debentures, bonds guaranteed by the province may be issued by the Hydro-electric Power Commission, as it is believed that these can be marketed to better advantage than by the municipalities. In order to make the load on the different municipalities as light as possible sinking fund charges will not be commenced for ten years. The bonds run for fifty years. The operation of the radials is taken out of the hands of the municipalities in this new bill and placed in the hands of the Hydro-electric Power Commission. The explanation given for this change is that it might be difficult to insure proper management of a number of small isolated systems and that the Commission is in a better position to appoint suitable men and to take charge of, in one office, much of the work that would necessarily be many times duplicated.

Vermillion, Alta.

The Town of Vermillion will soon be adding another unit of 50 kw. to its present power plant as it is now overloaded and cannot take care of the business offered.

The C. N. R. are sinking a well of 30 ft. diameter and approximately 35 ft. deep to supply their terminal with water. The pump will be a centrifugal driven by a thirty horsepower 500 volts, 3-phase, 60-cycle induction motor.

Vegreville, Alta.

The town of Vegreville have instructed Messrs. Maxwell and McKenzie to proceed with the plan and specification for a light and power plant to compete with the present light company. The by-laws were voted on in 1913 but owing to the condition of the financial market the town council could

not sell their debentures and the matter was postponed until this spring. The situation in Vegreville is rather complicated, the present light company has a franchise good for nine years, but the town claims that the service has been so unsatisfactory and the capital so limited that the company could not extend their lines to take care of the newer part of the town. Also their generating equipment being operated at full capacity they could not add on any more load.

Woodstock, Ont.

The water and light commissioners are considering the erection of a small sub-station and the purchase of the necessary transformers to take care of the increased requirements of the northwest section of the city.

Woodbridge, Ont.

On April 12 the ratepayers voted to spend $6,000 on a hydro-electric distribution system.

Walkerville, Ont.

A contract for the building of a low tension transforming station in Walkerville has been awarded to Wells & Gray.

Windsor, Ont.

A contract has been awarded by the city of Windsor to the William Hamilton Company, Peterboro, for the supply of all the ornamental iron standards required for the new street lighting system to be installed in the business district of the city of Windsor. There will be approximately 300 of these standards probably each equipped with magnetite arc lamps.

A contract for the erection of the transforming station has been awarded to the H. Christman Company of Hamilton.

Welland, Ont.

The Union Carbide Company have placed an order with the Siemens Company of Canada for a quantity of 46,000 volt single conductor cable. The cable will be paper insulated and lead covered and will, we believe, be the highest voltage cable installed in Canada to date. The specifications call for a test of 100,000 volts, both after manufacture and after installation.

Winnipeg, Man.

The Manitoba Government will build a new telephone exchange to take care of the St. James district.

A contract for the extension for the May Street sub-station has been awarded to G. H. Archibald.

The sixth annual report of the Manitoba Government telephones, which covers the fiscal year ending November 30, 1913, is just to hand. Substantial increases have been made during the year in the number of telephones. The total number of telephones in use is now 48,094, a gain of 5,173 for the year. These are, for the most part, government telephones. The total number of exchanges now operated by the government is 124 as against 16 operated by private companies and local municipalities. The number of urban subscribers to the government system is 34,039 as against 11,242 rural subscribers. The other systems have 483 urban subscribers and 2,330 rural. The total revenue for the year was $1,707,149; gross expenses $1,269,909, leaving net earnings of $437,240. The interest charges for the year take $406,975, leaving $30,265. Of this amount $26,691 is carried to replacing account, leaving a net balance of $3,574. The balance sheet indicates the total assets of the system to be $10,666,829.

The Siemens Company of Canada are shipping a 500 kw. motor-generator set for the King Street sub-station, Winnipeg. The unit consists of a 500 kw. d.c. compound wound generator, with commutation poles, 550/605 volts, 720 r.p.m. direct connected and mounted on the same bedplate with one self-starting synchronous motor 3-phase, 2200 volt, 60-cycles, with direct connected exciter. The necessary starters and rheostats are also included.

Lighting Schedule for May, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
May 1	11 30	May 2	4 10	4 40
3	0 00	3	4 10	4 10
4	0 30	4	4 10	3 40
5	1 00	5	4 10	3 10
6	1 20	6	4 10	2 50
7	1 50	7	4 10	2 20
8	2 10	8	4 10	2 00
9	No Light	9	No Light	
10	7 30	10	10 10	2 40
11	7 30	11	11 30	4 00
12	7 30	13	0 30	5 00
13	7 40	14	1 20	5 40
14	7 40	15	1 50	6 10
15	7 40	16	2 20	6 40
16	7 40	17	2 40	7 00
17	7 40	18	3 00	7 20
18	7 40	19	3 20	7 40
19	7 40	20	3 40	8 00
20	7 40	21	3 50	8 10
21	7 40	22	3 50	8 10
22	7 50	23	3 50	8 00
23	7 50	24	3 50	8 00
24	7 50	25	3 50	8 00
25	7 50	26	3 50	8 00
26	7 50	27	3 50	8 00
27	7 50	28	3 50	8 00
28	7 50	29	3 50	8 00
29	10 00	30	3 50	5 50
30	10 40	31	3 50	5 10
31	11 00	June 1	3 50	4 50

Total Hours 171 10

Electrical News

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Ugly Power Buildings

The Electrical News feels that it is not entirely without its province in calling the general attention of its readers to the inartistic style of building for power house and sub-station purposes that is being erected, for the most part, all over Canada. We make this reference with all due recognition of the necessity of keeping the cost of these buildings as low as possible, having in view satisfactory financial results. We do not suggest that the utilitarian side of such a plant be sacrificed to its artistic design, but it is very evident that the artistic has been made, in a great many cases, entirely subservient to the useful side of the station, when the addition of a few dollars, or perhaps even without this addition, a building which might have been a pleasure to the eye and a credit to the community has been made to stand out merely as a rough block of homely cement or brick work.

The trouble very probably lies in the fact that art and electrical power stations are two things never associated either in the mind of the engineer or the layman. Yet, what is more beautiful than the interior of a well designed, well equipped, and well kept electric station. Why then should the outside be ugly? Is there any single reason to justify the majority of the unsightly power plants one sees scattered throughout the length and breadth of our Dominion?

In this connection we have just stumbled across a little station which appeals to us as having been the work of a man who appreciated, to some considerable extent, his duty to the community in which he lives. In Clayburn, B.C., which even in the West has not yet aspired to the name of city, the operating company have built a little sub-station, without any additional cost, which makes one wonder some other stations have ever been allowed to stand. Doubtless the idea contained in this one is not perfect from an artistic point of view, but it certainly shows an appreciation of the requirements of the case and, as we said before indicates a patriotic interest in the general appearance of the town which this plant is designed to serve. A photograph of this sub-station is shown on another page of this issue along with a brief description of the plant. It will be seen that the sub-station is of very simple design, a bungalow type. Doubtless it could be improved in appearance, but there are few operating companies in Canada in a position to throw stones at it. We believe this is a step in the right direction and we are quite sure that our readers will agree with us that the sooner more attention is paid to the artistic side of our electric buildings the better it will be for the communities they serve individually. From every other point of view electricity, both in its generation and application is educative and refining in its tendencies. Is it not an anomaly then that electric buildings should be the least artistic of all our public structures?

Transit Facilities

An interesting topic and one of great economic importance at the forthcoming International Conference on City Planning will be the improvement of rapid transit facilities in our growing cities. A paper on "Provision for Future Rapid Transit: Subway, Elevated or Open Cut and their Influence on the City Plan" will be delivered by J. V. Davies, Consulting Engineer, Brooklyn Rapid Transit Company, and will be followed by another paper on "Rapid Transit and the Auto Bus" by John A. McCollum, Assistant Engineer, Board of Estimate and Apportionment, New York City. The positions these men occupy are a guarantee that they are well qualified to speak on transit problems, and their addresses will be awaited with much interest by those concerned with municipal affairs.

The transit problems of the present day have been made difficult by short-sighted city-planning in the past. How frequently do we see towns whose central, business streets are narrow and congested, while the outlying, residential sections have roadways that are broad and spacious! How universal in our large cities is the mechanical rule-of-thumb lay-out of streets in checker-board array, disregarding topography and natural routes of travel! The people of a generation ago can hardly be blamed for not foreseeing the tremendous development of electric traction and automobile traffic that has taken place in the last quarter of a century, but we of to-day are very stupid to go on planning our new cities on the model of the old. The building of skyscrapers is adding to the congestion in the centres of our cities and multiplying our traffic problems in the same ratio that it increases the population on a given area.

In connection with transit facilities, civic foresight must take heed of the franchises, contracts, and vested rights which public utility companies may be suffered to acquire. A franchise may confer a monopoly, but this monopoly should be carefully controlled. Only too seldom are public rights properly safe-guarded when granting privileges to large companies. The cities are not alone to blame. For example, legislatures may confer charters upon railway companies giving them the right to locate their lines where they please and perhaps to destroy the most carefully considered city plan because they are not amenable to municipal control. A similar observation applies to telephone and telegraph companies. The whole question of the granting of franchises and of the protection of public interests in relation thereto is a question that urgently requires the thoughtful attention of our public men.

Western Canada Power

Some interesting statements are published in the annual report of the Western Canada Power Company, Limited, by Mr. C. H. Cahan, president of the company. This power company has felt the pinch of the past twelve months as a result of the general unfavorable industrial conditions, and it is pointed out that the development of the company has been set back from twelve to eighteen months which means, presumably, that proposed installation of electrical equipment will be delayed approximately that length of time. The two units already installed by this company have been operating without mishap and though they have only a rated capacity of 9,000 kw. each, the company have a connected load of 30,000 h.p. The largest customer is the B. C. E. R. Company who are now taking something over 6,000 h.p. and who will eventually take, under their contract, up to 40,000 h.p. The Puget Sound Traction, Light & Power Company are taking 6,600 h.p. and the Western Canada Power Company have a further connected load in light, heat and industrial power of 15,500 h.p. During the year 1913 the power house generated 55,000,000 kw.

The Western Canada Power Company originally planned to utilize the waters of the Stave River at two points a few miles apart. The first of these was calculated to operate four 9,000 kw. units and the second to develop practically the same amount. The annual report states, however, that instead of constructing one dam 165 feet high for the second development it has now been decided that more economical development can be made by building two power houses for a 65-foot head and each capable of operating a 30,000 kw capacity. It is further stated that preliminary designs and estimates show that the whole development can be made at a cost of from $55 to $60 per h.p. If these estimates are realized it will mean that the Western Canada Power Company's total capacity at the three points on Stave River will be 96,000 kw.

Estimates are given in the annual report of the probable earnings for the next three years. These appear to be conservative but their realization will depend largely upon industrial conditions.

Toronto's Lower Rates

After considerable discussion the matter of rates for the Toronto Hydro-electric system has been settled by a final order from the Ontario Hydro-electric Commission that the rates be lowered from June 1st. The system of charging which in Toronto has not been quite in uniformity with the standard system laid down by the commission is now made to conform exactly with other municipalities. The rates beginning June 1st represent a reduction of approximately 10 per cent. all round and are as follows:—

Power Rate:—$1.00 per month per horse-power of connected load, or maximum demand of such load, where a suitable maximum demand meter is installed. In addition a consumption charge of 1.5c per kw.h. for the first fifty hours' use of the maximum demand; 1c per kw.h. for the second fifty hours' use of the maximum demand and 0.15c per kw.h. for all additional consumption. These base rates are subject to the following discounts: Class A (24-hour unrestricted use) no discount; Class B (24-hour restricted use) 10 per cent. discount; Class C (10-hour unrestricted use) 10 per cent. discount; Class D (10-hour restricted use) 33 1/3 per cent. discount. Monthly bills subject to a further prompt payment discount of 20 per cent.

Domestic Lighting:—4c per 100 sq. ft. of floor area, plus a consumption charge of 3c per kw.h. Prompt payment discounts of 20 per cent.

Commercial Lighting:—6c per kw.h. for the first thirty hours' monthly use of installed capacity plus 3c per kw.h. for all additional consumption. Prompt payment discount of 20 per cent.

Street Lighting:—A reduction of $1.00 per lamp for each 100 watt lamp used for the purpose of street lighting, for both single and cluster lights. This makes the future price $8.00 per 100 watt lamp.

Electric Vehicle Association Growing

At the time of the last convention in Chicago the Electric Vehicle Association had 437 members. At present writing over 650 members are enrolled, an increase of over 200 members, or at the rate of about 600 a year. It is hoped that by the time of the next Convention, to be held in Philadelphia during October (the exact date to be announced shortly) that the one thousand mark will have been reached.

It will be interesting to note also that last year only two sections—New England and Chicago—existed. Now, sections are organized in New England, Chicago, Philadelphia, Washington, Cincinnati, and San Francisco—the last two sections being very recently added. It is expected that by the time of the Philadelphia Convention the present six sections, representing a growth of 300 per cent. in about six months, will have increased to between ten and fifteen sections.

These increases in membership and section formation, which permits of very direct, constructive work in various localities, is indicative not only of the strength of the Electric Vehicle Association, but the extremely healthy condition of the electric vehicle industry as a whole.

Municipal Lighting System

At the suggestion of the Montreal controllers, Mr. Parent, the superintendent of lighting, will prepare a report on the cost of installing a plant for 500 street lights for the central district. The question arose out of a dispute between the city and the Montreal Light, Heat & Power Company as to the charges to be made for new lights on St. Catherine Street and Bleury Street, where the underground conduits have been laid. The company ask $156 for each lamp, including equipment; $143 per lamp, the city supplying a portion of the equipment; and $83 if the city supplies the entire equipment. The present price is $72.70 per lamp, but the company deny that they are liable to supply lights by the underground conduit distribution at the price fixed under the present contract. This is for overhead service, and the company contend that the city must pay a fair differential for underground service, the latter being relatively more costly than overhead service. In addition the capital charges involved will have to be written off in six years. The company are willing to arbitrate the matter in a friendly way. The city on the other hand repudiate liability for a higher charge except where the use of a special lamp will result in additional expense.

G. T. P. Telegraphs and Telephones

Mr. A. Bruce Smith, manager of telegraphs of the Grand Trunk system, was present at the driving of the last spike on the Grand Trunk Pacific, and also superintended the completion of the telegraph wiring. The system is now built between Port Arthur and Prince Rupert, but there is at present only a commercial service as far west as Prince George. Commercial messages will be accepted in a short time through to the Pacific Coast. Wires are now strung along 2,200 miles of main line, exclusive of branch lines, in Manitoba, Saskatchewan, Alberta and British Columbia. Nearly six thousand miles of copper wire have been erected. In addition to the telegraph service the Grand Trunk Pacific is making rapid headway with the installation of the Selective Telephone Train Despatch System.

Electricity in Clay Products Plant

The Clayburn Company, of Clayburn, B.C., manufacturers of all classes of clay products, including all kinds of fire clay goods, have recently completed electrifying their entire plant.

The factory is situated about a mile from the C. P. R. and B. C. E. R. and the clay and shale deposits are 3½ or 4 miles from the factory. The Clayburn Company have 6 miles of railroad including side tracks.

Their original power equipment consisted of a 150 h.p. steam engine for factory drive, a 15 h.p. engine for fan drive, and two steam locomotives. It became apparent some time ago that this equipment could not meet the requirements and as the Western Canada Power Company were extending their lines in this direction the managing director of the Clayburn Company, Mr. J. B. Millar, recommended the electrification of the plant. A temporary sub-station was built and a few motors installed which proved such a success that last summer a permanent sub-station was erected in place of the old one. The new one is built in bungalow style, Fig. 1, clinker brick outside, and lined with different colored pressed brick tastefully arranged. The floor is of cement, smooth finished, and the ceiling pressed steel which makes the building entirely fireproof. The inside dimensions of the substation are 33 ft. by 22 ft.

The Western Canada Power Company's 12,000 volt line is led to a pole at the rear of the sub-station and brought into the station under ground, using submarine cable. The current passes through knife switches to a hand-operated oil switch mounted on a slate panel, to 12,000 volt bus-bars; thence to three single-phase 167 kw. C. G. E. transformers, where it is stepped down to 2,300 volts and brought under the floor, through an oil switch, and delivered to the Clayburn Company's bus-bars.

The switchboard consists of 8 slate panels, block marine finish. Panel 1 controls the W. C. P. Company's 2,300 volt outgoing line to supply house lighting.

Panel 2, the W. C. P. Company's 2,300 volt feed to the Clayburn Company's bus-bars.

Panel 3, the Clayburn Company's 2,300 volt feed going to

Sub-station of Clayburn Company, Clayburn, B.C.

three 50 kv.a., 2,300 to 220 volt, transformers located on a rack just outside the station, shown in Fig. 1; a 220 volt service is then brought back to panel 8 through a 600 amp. 4-pole knife switch and distributed to four 3-pole knife switches; one of these switches controls a circuit leading to a 50 h.p. Allis-Chalmers motor which drives a soft mud plant for making common brick; this plant has a capacity of 33,000 bricks per day of 10 hours. Another of these switches controls a circuit leading to a 40 h.p. Allis-Chalmers motor which drives a fan 24 hours per day. Another switch controls a circuit leading to a 20 h.p. Allis-Chalmers motor driving a fan 24 hours per day. The fourth switch controls a circuit having three 5 h.p. motors; one motor drives an air compressor, compressed air being used for the factory whistle and cleaning out the motors; another 5 h.p. motor drives an elevator for handling coal and the other motor is connected to an emergency pump to be used in case of fire. On the same panel there are 4 double-pole switches for lighting circuits.

Panel 4 controls the Clayburn Company's 2300 volt cir-

Interior Clayburn Company's sub-station.

cuit leading to a 200 h.p. Allis-Chalmers motor which replaced the 150 h.p. steam engine for factory drive. The capacity of this factory is 50,000 bricks per day and consists of 3 dry pans, 2 dry press machines, pug mill, auger machine, wire cut and repress machine, as well as elevators, shafting, etc. There was considerable trouble keeping them all going with the steam engine but no trouble has been experienced since the motor was installed. In making press brick it is necessary for the dies to be heated; steam was originally used for this purpose but the company now use Can. Gen. Electric heating units. Panel 5 is a spare to take care of future extensions.

Panel 6 controls a 2,300 volt lead to a 125 kw. Westinghouse motor-generator set which generates power to drive a 10-ton Westinghouse-Baldwin locomotive. The original steam road has been electrified and the two steam locomotives have been replaced by one electric. It is found that one electric locomotive will give about twice the service that one steam locomotive did. Panel 7 controls the d.c. side of the motor-generator set.

Armoured cable was used in all circuits in or out of the sub-station and all leads are under ground.

There seems to be doubt in the minds of some manufacturers as to the success of electric drive in the brick making industry but Mr. J. B. Millar has proof at Clayburn that electricity for brickmaking is a success from any point of view.

Canadian Electrical Association Convention

The annual convention of the Canadian Electrical Association will be held this year in Montreal on June 24, 25 and 26. The headquarters of the convention will be in the new club rooms of the Canadian Society of Civil Engineers, Mansfield Street. At a recent meeting of the executive branch committees were formed including a convention committee of Montreal men, a committee in Toronto to co-operate with them, a papers committee, etc.

Keokuk Transmission Lines

The power of the Mississippi River Power Company, one of the largest hydro-electric plants in the world, is transmitted for the most part to St. Louis, a distance of 144 miles, at 110,000 volts. There are, however, several branch lines tapped off the higher voltage lines for serving districts along the way. These include 29 miles of 66,000 volt line; 28 miles of 33,000 volt line and 42 miles of 11,000 volt line. Some interesting details in connection with these lines are given herewith.

The high tension line to St. Louis is a double circuit steel tower line built on a 100-foot private right-of-way. The normal span is approximately 800 feet and the longest, crossing the Missouri River, is 3,180 feet. The towers are all of the four-legged square base construction, the standard type having a total height of 79 feet, a base measurement of 20 feet square and a weight of 6,800 lbs.

Strain towers are used at all angles on both sides of railroad crossings and for approximately every tenth tower on tangents. Strain towers have a total height of 74 feet, base 24 ft. x 24 ft. and a weight of 10,500 lbs. The conductors are dead-ended at all strain towers.

The line conductors consist of a nineteen strand medium drawn copper cable having an area of 300,000 circular mils. The three wires of each circuit are arranged in tandem at elevations of 50, 60, and 70 feet respectively above the ground. The two circuits on opposite sides of the towers are separated by about 18½ feet, the top wires being slightly closer together than the bottom wires. The cables have an ultimate strength of 14,000 lbs. which gives a factor of safety of 2 under the supposed worst load conditions, which are estimated to be a one-half inch coat of ice, a sixty mile wind and 0 deg. F. For an 800 foot span this works out to a load of not more than 7,000 lbs.

Fig. 1. Strain insulators at Missouri River crossing.

The suspension insulators on the standard towers consist of series groups of seven 10-inch disks. On anchor towers each conductor is held by two series groups in parallel, each group consisting of eight ten inch disks. The suspension insulators were subjected to a rain test of 330,000 volts and to a dry test of 440,000 volts. The corona voltage of the line is approximately 150,000 volts which gives considerable margin above the operating voltage of 110,000.

The ground wire is one-half inch diameter, seven strand. galvanized Siemens-Martin steel mounted on the apex of the towers.

All towers are provided with heavy reinforced concrete foundations. The foundations of the standard towers extend 6 feet below the surface of the ground and of the strain towers 8 feet below the ground.

The crossing of the Missouri River necessitates one span 3,180 feet and another 2,350 feet with a tower 235 feet high located on an island near the middle of the river. The conductor used on these long spans is a ⅝-inch, nineteen strand core of special high tension steel with an outer stranding of twenty No. 10 B. & S. hard drawn copper wires, making a total diameter of ⅞ inches. These conductors are fastened rigidly to the towers by a group of six parallel series insulators each consisting of eight 10-inch disks as shown in Fig. 1. This figure also shows the system of equalizing levers providing for dividing the strain equally among the six strings of insulators. The ultimate strength of each of these conductors is 52,000 lbs. and of the insulator banks 60,000 lbs. As the worst load conditions are calculated to be 24,000 lbs. this thus provides a large safety factor.

Fig. 2. Type of 66,000 volt wooden pole line.

Each of the two circuits has a capacity of 45,000 h.p with a voltage drop of 10 per cent. and an energy loss of approximately 10 per cent.

The telephone line parallels the transmission line for the entire 144 miles. It is built on one side of the right-of-way and consists of two No. 8 telephone conductors, and a ground wire, mounted on 30-foot cedar poles spaced 125 feet. Houses for the patrol men are provided every 18 miles and telephone booths every four miles.

The 66,000 Volt Line

The conductors for the 66,000 volt line are supported on H-frame wooden pole structures spaced 300 feet. These are shown in Fig. 2. The structures consist of two cypress poles six inches in diameter at the top and 45 feet high, with wooden cross arms made up of two pieces 2-in. x 8-in. x 16-ft. Three No. 2/0 stranded copper conductors are supported in a horizontal plane as shown in Fig. 2 by four-disk suspension insulators. Two ground wires 5-16 inch diameter Siemens-Martin galvanized steel strand, are carried on the top of the poles. Two No. 8 copper clad telephone wires are supported on brackets on the sides of the poles.

The 33,000 volt lines consist of No. 2/0 stranded hard-drawn copper, mounted on pin type insulators, carried on 40-foot poles, spaced approximately 140 feet apart. A ½-inch galvanized steel strand ground wire is mounted on top of the pole and two No. 8 telephone wires are carried on cross arms below the conductors.

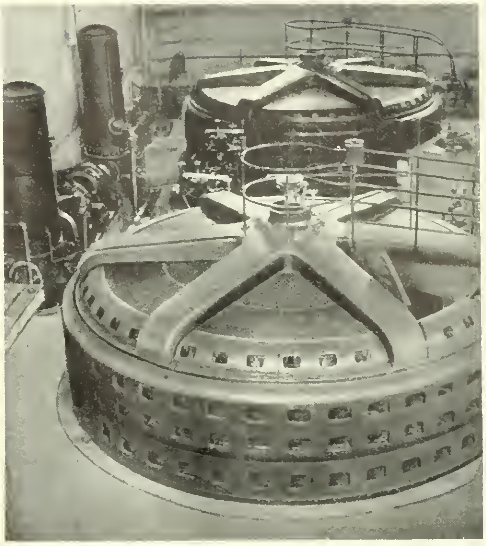
Kananaskis Falls Plant Completed

A few further notes and illustrations in regard to the Calgary Power Company's new generating station on the Bow River will be of interest to our readers.

It will be remembered that the Calgary Power Company have been building their second hydro-electric plant on the Bow River about 50 miles west of Calgary. The first development was at Horse Shoe Falls, the second about two miles up stream at Kananaskis Falls. At the Horse Shoe Falls where the full capacity is now installed there are four units with a total capacity of 18,000 h.p. Generation is at 12,000 volts which is stepped up to 55,000 volts for transmission to Calgary. Power is also supplied to Exshaw for cement and other manufacturing purposes at 12,000 volts.

The new Kananaskis station contains two units of approximately 6,000 h.p. each which brings the total of the two plants to 30,000 h.p. capacity.

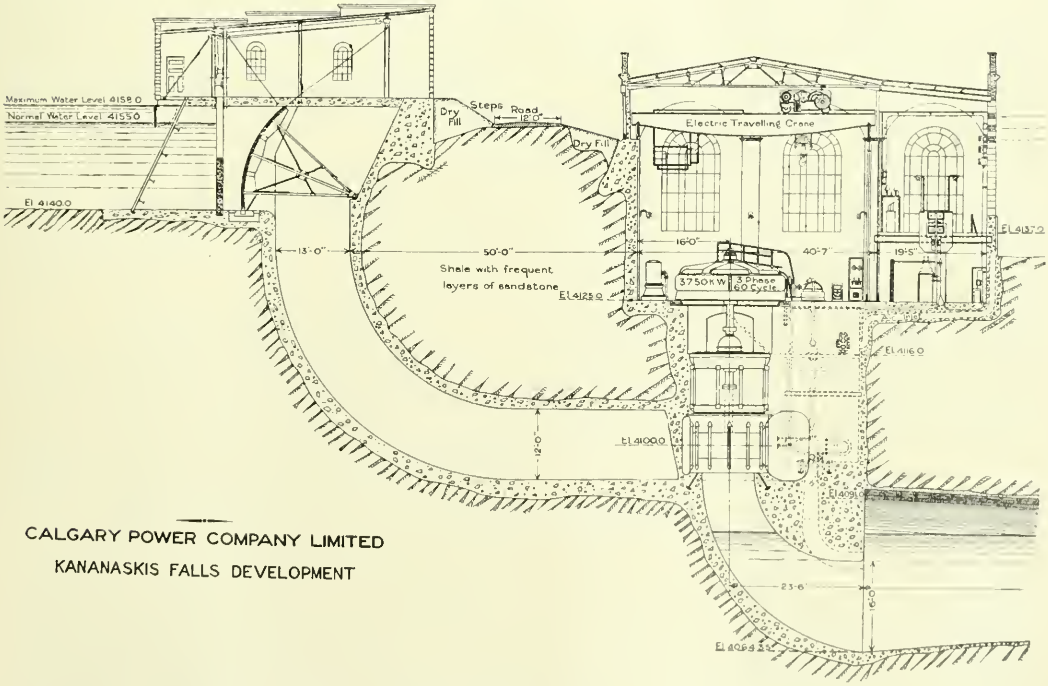
General construction work and the first unit installation in the power house at Kananaskis being nearly completed about the middle of December last, the result of a year's labor was appreciated in the starting up of the first wheel and generator to the satisfaction of the company. When the concrete structure of the dam was entirely completed, the head water canal inlaid with concrete as far as necessary, and the head works ready for operation, stop logs were gradually inserted in the several sections of the dam by means of an electrically operated winch, the forebay raised to its ultimate elevation of 3155 feet above sea level, and the head-water filled the dam to its working depth of 15 feet. The water flows through cleaning racks and enters the pressure tubes (of concrete) through four stop log sections, regulated by four tainter gates, two for each pressure tube, and



Interior Kananaskis Falls generating station.

raised by means of hand operated winches. Water enters each turbine from a small chamber, through wicker gates, and discharges into draft tubes (of concrete) and is carried through tunnels to the river below.

The hydraulic installation at Kananaskis Falls consists of two vertical type turbines, 5,800 horse power each, manu-

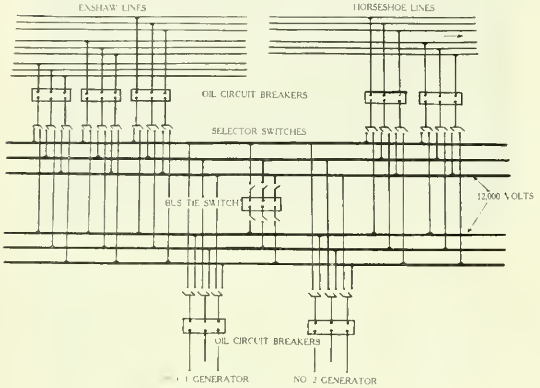


Section of Calgary Power Company's No. 2 generating statinn, situated at Kananaskis Falls, Bow River.

factured by the Canadian Allis-Chalmers, Limited, and supported by the Kingsbury bearing; the turbines are single runner wheels to operate at 164 r.p.m. They are direct connected to two vertical generators 4,250 kv.a., 12,000 volts, 60 cycle, 164 r.p.m., built by the Swedish General Electric Company. Turbines are controlled by Canadian Allis-Chalmers hydraulic governors, motor operated pressure pumps.

One turbo-exciter is installed, 75 kw., 220 volts, 600 r.p.m., and one motor-generator exciter of the same capacity, both Swedish General Electric. A 50-ton electrically operated crane is installed for the handling of heavy material.

On the main floor is situated all switching apparatus which consists of a main control board of eleven panels, vertical type, of dull finish slate, containing meters, relays and remote control devices, a station service board, a lighting panel and storage battery charging panel, all installed by the Canadian Westinghouse Company. On a gallery above the switchboard are erected the 12,000 volt buses and electrolytic lightning arresters, above which the five outgoing lines are run through the wall. Space is provided at one end of the main floor for a machine and workshop. The floor is inlaid with tile presenting a very pleasing appearance.



Wiring diagram, Kananaskis Falls station.

The transmission system has been designed for great flexibility. No. 2 plant is provided with two 12,000 volt busses, to either of which both generators can be cut in at any time. This station is also tied in with No. 1 station by two copper-aluminium circuits, either line to be closed in on either bus at pleasure. Power is transmitted to the Canada Cement Company at Exshaw over three 12,000 volt circuits which can also be cut in on either bus; so that electric power can be transmitted at any time from either or both stations to either Calgary or Exshaw or both. Voltage is stepped up in No. 1 (Horse Shoe Falls) plant from 12,000 volts to 55,000 volts for transmission to Calgary. There is no high tension transformer installation at Kananaskis Falls.

Hamilton Section C. E. A.

The Hamilton Section of the C. E. A. held its May meeting in the Section Room, Terminal Building, Thursday evening, May 7th. There was an attendance of 50, consisting of members and friends. The special feature of the evening consisted of a vaudeville entertainment under the subject of "Hooked Up" or "Landing a Customer." The act showed the lighting service of the Hamilton Electric Light & Power Company, tracing the contract and all the necessary work that it entails from the time the customer first makes application for light until the rendering of the bill. The dramatizing was a very good success.

Washing Machine Contest

The Electric Club of Chicago a year ago conducted an early summer advertising campaign which was designed to familiarize the public with the electric washing machine. This campaign consisted of advertising, direct-by-mail matter, and personal solicitation. As a premium they presented to the winner one of their electric washers.

The contest was for the best article describing the savings made possible by the use of an electric washing machine. The contest was open to all. Blanks were furnished the competitors as an aid in preparing their lists of savings. This plan showed spaces for estimating saving in wages, food and car fare for servants and washerwomen, labor, fuel, soap, wear and tear on clothing and materials washed, tearing out buttons, laundry damaged, laundry losses, cleaner's bills, time, space, damage from steam in the room, long boiling, health.

The idea is a good one for central stations to follow in that it tends to advertise and popularize the use of this or any other electric appliance. Some of the advantages given in the contest by the contestants were exceedingly forceful, not the least of which was contained in one letter which related that all the members of a certain household had contracted measles from a washerwoman. The winning estimate of savings for one year in a household of average size is printed below. At first sight it looks large, but if one compares the actual figures attached to any one item with one's actual experience it will probably be found that in many cases the figures are too low. This item of expenditure is, for the most part, one not treated in detail by the average domestic book-keeping department and probably runs into much bigger figures than is generally supposed.

Wages to servants and washwomen	63.00
Food and carfare to servants and washwomen	8.40
Labor	22.00
Fuel	6.30
Soap	4.50
Wear and tear on clothing and materials washed	13.50
Tearing out buttons	.60
Laundry damage, such as marks of iron rust, etc.	1.30
Laundry losses	2.70
Cleaner's bills	6.00
Time	37.80
Space	10.50
Damage from quantities of steam in the room	2.75
Long Boiling	1.00
Health	4.20
Total	$185.05

Montreal Suburban Extensions

In continuation of the electric lighting of the lakeside district, just outside Montreal, a contract is being carried out by Mr. W. G. H. Cam, Montreal, for the lighting—street and domestic—of Beaconsfield and Beaurepaire, from plans by Mr. G. W. Thompson. The lines will be 4½ miles long, and power will be supplied by the Montreal Light, Heat & Power Company, from the sub-station at Lakeside to a distributing station at Point Claire, and thence to a sub-station at Beaconsfield which will be built by the Beaconsfield Council. This sub-station will be constructed of brick and will contain a small transformer, panel board, etc. The lighting system will consist of 100 6.6 ampere lights, 60 c.p.; tungstens will be installed at first, but will afterwards likely be changed to the nitrogen filled type. The poles will be 30 feet high, placed 125 feet apart, with a light on every alternate pole. There will be about 12 transformers, the highest capacity being five kw. The Canadian General Electric Company are supplying the electrical equipment.

Details of Brentwood Bay Steam Plant

From time to time, we have printed in the Electrical News brief reference to the electrical equipment at the Brentwood Bay steam plant of the B. C. E. R. Company, but we are glad to be able to give our readers a very complete detailed description of the whole plant covering not only the electrical side but the steam units and all the necessary auxiliaries. We are also reproducing a plan and section of this plant which may well be considered as representing at every point the highest standard of modern engineering efficiency.

The city of Victoria is the capital of the Province of British Columbia, and is finely situated at the southern end of Vancouver Island, in one of the most fertile districts of the Province. During the years 1910-1911, the rate of growth of this city was altogether abnormal, and in the spring of 1912 it became evident that the Vancouver Island Power Company, Limited, one of the subsidiary companies of the British Columbia Electric Railway Company, Limited, which supplies Victoria and its surroundings with electrical energy, would be compelled to increase the capacity of its generating plant with the utmost possible despatch.

The company had at that time in operation its hydro-electric plants at Goldstream and at Jordan River. The latter plant was placed in operation in the autumn of 1911, thus increasing the capacity of the system by 8,000 kw., but nevertheless, the load continued to grow at such a rate that this increase appeared to be inadequate to met the probable demands of the winter load. In such a limited period of time, further additions to the hydro-electric plants could not be made, and the installation of an auxiliary steam plant was, therefore, decided upon.

During the past few years, Messrs. C. C. Moore & Company of San Francisco, have installed a number of steam turbine units in Vancouver for the B. C. E. R. Company, and their work had been so expeditiously carried out that it was decided to award the contract for construction of the new steam plant on Vancouver Island to that firm, the contract being on a "cost plus fixed sum" basis. The electrical portion of the work was carried out by the company's forces.

After a careful investigation of the sites available for the plant, Brentwood Bay on Saanich Inlet was selected as the most suitable location. The new plant is thus about 12 miles north of Victoria, and in close proximity to the British Columbia Electric Railway Company's Saanich interurban railway. A very suitable site was obtained on this bay; there is an ample supply of water within easy suction limits for condensing purposes, and the water is of such depth that large oil tank steamers can deliver their cargoes with ease and safety. A construction camp, consisting of 40 canvas tents with the necessary cook houses, was built, and active construction work was commenced on June 1, 1912.

The Plant Site

The site of the plant was covered with a heavy growth of timber; this timber was cut and removed, the stumps were grubbed out, and the refuse burned. Great care had to be taken in burning the stumps to prevent the spreading of the fire to the surrounding timber.

The overburden at the site averaged about 2 feet in thickness, and amounted to about 3,500 cubic yards; the underlying rock was of an igneous nature, but it was badly shattered and weathered rapidly. The surface of the ground sloped up rapidly from the shore, and in order to keep the plant within suction limits, a considerable depth of excavation was necessary at the back of the building. The quantity of excavation amounted to about 27,000 cubic yards. On account of the difficulties involved at that time in taking in construction plant, a steam shovel was not used all excavation being done by cars and track. The cars were of 1 cubic yard capacity and were filled by hand.

The preliminary work was carried out by night and day shifts, and the contractors experienced considerable difficulty in securing the necessary labor, as work in Victoria was plentiful. Although the work was pushed as much as possible, the machinery began to arrive before the foundations were in place.

The Plant

The proposed ultimate development of the Brentwood Bay steam plant is 20,000 kw. The preliminary installation consists of two 2,000 kw. Allis-Chalmers turbo-generators, as much better delivery could be obtained on units of this size than on 5,000 kw. units. The 2,000 kw. units are so located in the middle of the turbine room that they can be replaced by 5,000 kw. units, if this course is found desirable. The location of the 2,000 kw. units is also arranged so that if these units are left in place, one 7,500 kw. unit can be placed on each side of the existing units.

The generators as well as the turbines were supplied by the Allis-Chalmers Company. Three-phase, 60-cycle current is generated at 2,300 volts, the speed of the units being 1,800 r.p.m. In addition to the steam driven units, two 500 kw., 600 volt d.c. generators direct connected to one 1,500 kv.a., three-phase, 60-cycle, 2,300 volt synchronous motor are provided.

A space is provided in the transformer room for three banks of three single-phase, 2,300/60,000 volt, 2,000 kv.a. oil insulated, water-cooled transformers. At present only one bank of transformers is installed, together with one spare transformer. For the 11,000 volt feeders, one bank of three 1,000 kv.a. oil insulated, water-cooled transformers is provided for stepping down from 60,000 to 11,000 volts.

Building

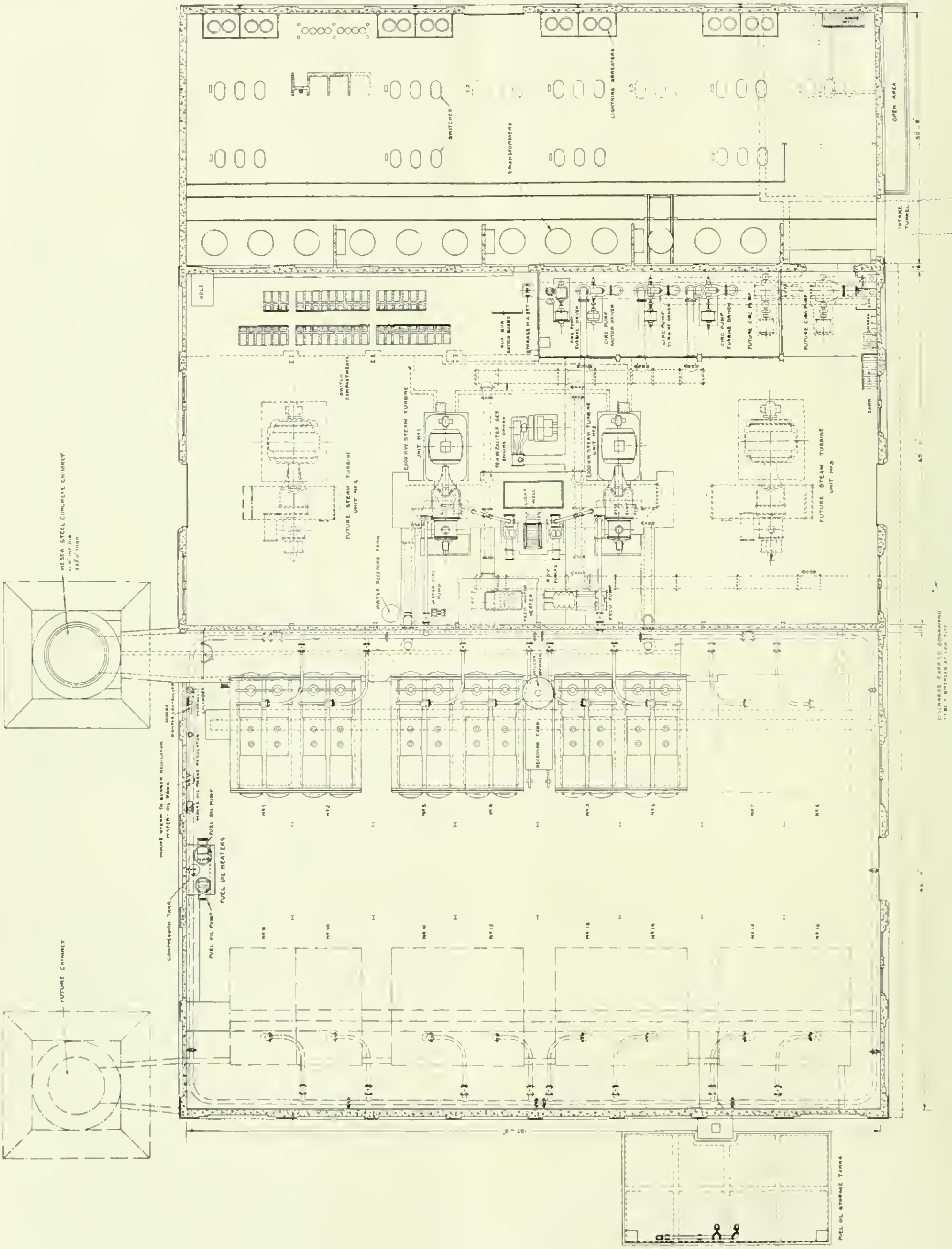
The building is of steel frame construction, with reinforced concrete curtain walls. The structural steel in the boiler room is of sufficient strength to support overhead bunkers suspended between the boilers, should it ever be desired to use coal fuel. The building is divided into three main compartments by walls separating the boiler room and the turbine room, and between the turbine room and the substation. The windows are of ample size.

Boilers

There are six Babcock & Wilcox Patent Safety Water Tube Boilers of forged steel construction, arranged in three batteries of two each. Provision has been made in building for the later installation of ten additional boilers, making a total of sixteen. These boilers were built by Babcock & Wilcox, Limited, of Glasgow, Scotland. Each boiler consists of eighteen sections, each having twelve 4 in. tubes, 18 feet long, over which are mounted two steam and water drums, 48-in. diameter and 24 ft. 3 in. long. The total water heating surface of each boiler is 4,780 square feet. The boilers are designed for a working pressure of 200 lbs. per square inch, and are in accordance with the standard construction of Babcock & Wilcox.

Superheaters

Each boiler is equipped with one Babcock & Wilcox forged steel superheater designed to give from 80 to 100 degrees Fahrenheit superheat at the boiler nozzle when using California fuel oil. If coal is adopted as a fuel, special baffling will be necessary to prevent excessive superheat, as the same amount of surface is not necessary for coal as for oil fuel.



General plan Brentwood Bay Steam plant, Vancouver Island—B.C.E. Ry. Co.

Furnaces

Each boiler is provided with a Peabody patent fuel oil burning furnace, this furnace affording the most efficient boiler performance with crude oil. The furnace is fired from the bridge wall forward, but is controlled at the boiler front. The distribution of flame is over a large area of boiler heating surface, preventing localization of heat and blow-pipe action and minimizing the possibility of burning out tubes. The furnaces are arranged for the use of three burners per boiler.

Exciters

For excitation purposes, a 75 kw., 125 volt, d.c. generator, direct connected to a simple side crank non-condensing, enclosed, self-oiling, automatic engine built by A. L. Ide & Sons, is provided. This exciter is placed between the main units. The engine is designed for the same pressure and superheat as the main units, and it operates very satisfactorily under these conditions of service.

One 75 kw., 125 volt, d.c. generator, direct connected to one 110 h.p., 3-phase, 60 cycle, 2,300 volt induction motor, is also provided for excitation purposes, for use at light loads when the use of the steam-driven unit would cause an excess of auxiliary steam over that required for the heating of the feed water, with its attendant loss of economy.

These generators and motors were supplied by the Canadian General Electric Company.

Condensers

Each turbine exhausts directly through a corrugated copper expansion joint into a Wheeler Admiralty surface condenser of the dry tube type. Each condenser contains 4,000 square feet of cooling surface. The tubes are brass, ¾-in. diameter, No. 18 B.W.G. The dry plates in the condenser drain off the water of condensation as it is formed and allow it to fall to the bottom of the condenser, where it is withdrawn by the hot-well pump. This arrangement prevents the condensation which takes place in the top portion from drowning the lower tubes, thus increasing their rate of conductivity. At the same time the temperature of condensation is increased, the temperature of the air pump suction reduced, and the quantity of circulating water required is diminished. The low temperature of the air pump suction decreases the volume of air to be handled, thus reducing the necessary displacement.

Air Pumps

One Wheeler patent rotative dry vacuum pump of the yoke frame crank and flywheel type is furnished with each condenser. These pumps are of the flashport valve type by which the air compressed in the clearance is automatically transferred to the vacuum side of the piston prior to starting the return stroke. This reduces the effective clearance to a minimum, and increases the volumetric efficiency to a maximum.

Hot-Well Pumps

There is furnished with each condenser and placed directly under it, one cast iron hot-well with a direct connection to a 2½-in. special centrifugal hot-well pump. These pumps are brass fitted, have specially constructed passages to give easy access to the throat of the runner, and each is driven by a 7½ h.p. Kerr steam turbine, operating at 2,400 r.p.m.

Circulating Water Pumps

Three 14-in. Wheeler centrifugal circulating pumps are provided. These are brass fitted throughout. Two of these pumps are direct connected to, and driven by, Kerr steam turbines; the third pump is motor driven. Each pump is of the double suction balanced type and draws its water from a pump pit located directly below, and which will later be described. The water is discharged through individual multiple check valves.

Boiler Feed Pumps

Two Warren horizontal, duplex simple, steam-driven boiler feed pumps mounted on cast iron drip pans, are provided. The pumps operate non-condensing, each pump being of ample capacity for the present plant, the other being in reserve.

Feed Water Heaters

One Cochrane open type feed water heater is provided. This heater receives the hot-well pump discharge and make-up water at the top and distributes it over iron trays from which it falls in a finely divided spray. The auxiliary exhaust is passed through this spray, condensing it and at the same time imparting its heat to the feed water. Ample storage space is provided in which to care for the ordinary variation in water level in the heater reservoir due to fluctuation of load. The supply of auxiliary exhaust steam available can be regulated by the use of either steam or motor-driven circulators, as may be required, so as to obtain a maximum temperature of feed water, and at the same time utilize all the auxiliary exhaust without waste.

Fire Pump

In the pump pit has been installed an Underwriters' fire pump fitted for salt water and connected to a hydrant system throughout the plant. This pump is of the multi-stage centrifugal type and driven by a Kerr steam turbine of suitable power and speed. The pump has a capacity of 750 gallons per minute, against a pressure of 100 lbs.

Main Oil Storage Tanks

Located about 500 feet away from the plant and at an elevation above it, two steel oil tanks each of 5,000 barrels capacity are provided. Each of these tanks is fitted with the necessary connections for filling and emptying, besides heating coils, smothering pipes, drain pipes, etc. The tanks are placed on specially prepared sand foundations and have been surrounded by earth embankments of such diameter and height as to contain one and one-half times the contents of the tank. These embankments are a safety feature provided against the possible failure of the tanks. The tanks are provided with metal covers with access doors and permanent ladders inside and outside. A specially constructed filling pipe has been provided, by means of which the tanks are filled from oil barges or oil tank steamers.

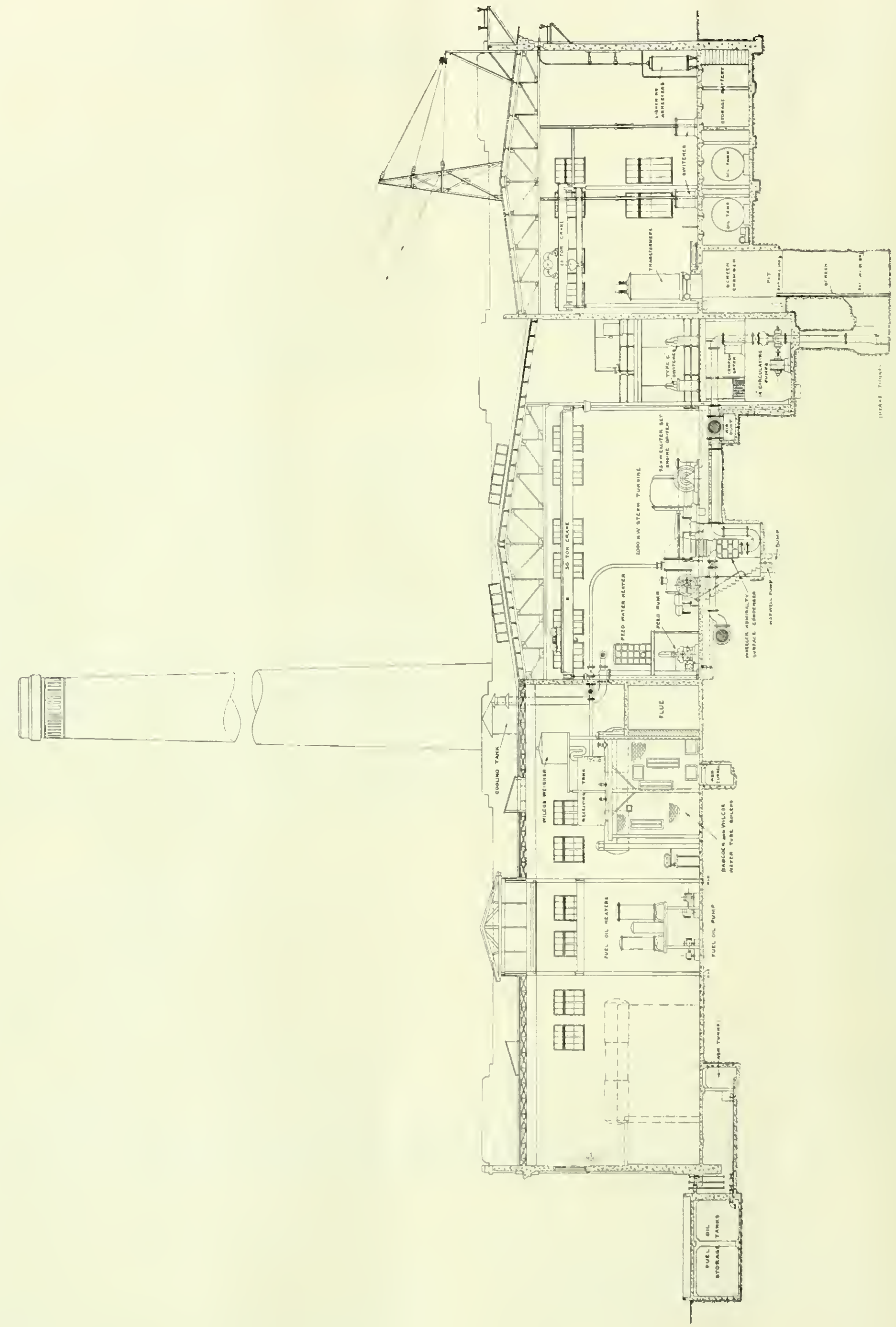
Auxiliary Oil Tanks

The oil pumping equipment by which the burners are fed is not directly connected to the main oil storage tanks. For daily use, two 600 barrel auxiliary oil tanks are provided. These are made of reinforced concrete. The ground is excavated to receive them and the two tanks are built side by side, of a rich concrete mixture and below the level of the boiler room floor. The tanks are fitted with the necessary measuring devices, filling pipes, oil suctions, smothering pipes, heating coils, manholes, etc.

Moore Automatic Fuel Oil Regulating System

The combustion of the fuel oil is automatically controlled by the Moore automatic fuel oil regulating system, invented by Mr. J. R. Atchison and Mr. C. R. Weymouth, of Messrs. C. C. Moore & Company. In this system the fuel oil is pumped to the burners under pressures varying from 10 to 50 pounds per square inch, depending on load conditions, there being a uniform oil pressure throughout all portions of the plant, all burners being wide open, or nearly so. The amount of oil burned with variation of load, is controlled by the pressure of oil at the oil pumps, the intensity of fire increasing and decreasing in all boilers simultaneously.

The oil pressure is automatically controlled by a steam pressure regulator, the variations in oil pressure and intensity



Section through Brentwood Bay Steam Plant, Vancouver Island, B. C.—B.C.E. Ry. Co.

of fire being such as to maintain a uniform steam pressure on the plant.

For atomizing purposes, steam is supplied to the oil burners by a separate low pressure main, the pressure in this main being automatically controlled by variation of the oil pressure in the oil main. A ratio regulator is used, automatic in its action, which maintains such steam pressure in the low pressure steam main as is necessary for atomising the particular amount of oil burned, corresponding to any momentary oil pressure.

The air supply for combustion is controlled by a damper controller, also automatic in its action, which increases the damper opening with an increase in oil pressure and vice versa. The movement of the controlling lever is controlled by the action of the oil pressure on a diaphragm. This movement is opposed by the action of a spring, so that the amount of movement on the main lever is proportional to the oil pressure. This movement is multiplied through a hydraulic cylinder connecting to a rock shaft running over all of the boilers in one panel. Each boiler damper is connected to this shaft, and the connecting levers are set at such angularity, with respect to the connecting rods operating the dampers, that the proper air supply is provided for the various ranges of load, the final adjustment being from actual trial at the plant.

In actual operation and test, it is found that this automatic system of control is safe, reliable, and meets with the approval and hearty endorsement of the firemen. Owing to the fact that the firemen's work is very much simplified by the use of these regulators, they are as much desired by the firemen of the plant as by the management. Were it not for this accord, such automatic contrivance could not be successfully installed and operated.

Piping System

On completion of the ultimate plant, the boiler room main steam piping will form a complete ring with properly located isolating valves. All main steam piping is made up with an improved type of Van Stone joints, and fittings are avoided by the use of welded nozzles. Special anchorages are provided on the columns of the building, and liberal bends are used to take up expansion and contraction. Between anchorages at proper intervals, heavily constructed sliding supports are installed. No cast iron fittings are used on superheated steam lines, and all flanges and bolts are constructed with the idea of making an especially tight system of piping. Following the latest practice, no valve is placed between turbine exhaust and condenser, and should it be desired to operate the turbine non-condensing the steam passes through the top portion of the condenser to the atmospheric exhaust valve. Experience has shown that the conditions under which it might be necessary to operate in this manner are so remote that consideration need not be given to them in comparison with the losses incidental to the air leaks prevalent when using the valve and necessary fittings.

Non-Conducting Covering

All high pressure steam piping is covered with an extra thickness of 85 per cent. carbonate of magnesia sectional covering. Valve bodies and flange covers are also provided throughout. The effect of this heat insulation has been to reduce the attendant pipe radiation, which is particularly desirable on account of the long periods of time during which the plant may be held in reserve with steam pressure maintained.

Chimney

The chimeny is constructed of reinforced concrete with a separate concrete lining and air space extending up one-third of its height. It is 255 feet high and 11 feet inside diameter at the top, and is one of the biggest chimneys in Canada. It is of sufficient capacity to serve eight boilers when operating with coal fuel, and is, therefore, more than able to supply ample draught for the present boiler installation. This chimney is far more pleasing to the sight than the more common type of cylindrical concrete chimney. A brick flue with a concrete cover connects the boilers to the chimney.

For convenience in handling, erecting and repairing machinery, a 30-ton, hand-operated, travelling crane was installed.

Circulating Water System

Cast iron circulating water pipes were used throughout. A large water receiving pit was blasted out of the rock directly below the pumps and this was connected by tunnel with the deep water. Screens of ample area were installed at the mouth of the tunnel. A cast iron discharge pipe, extending below the surface, provides a water sealed return which, due to siphon effect, reduces to a minimum the heads against which the pumps have to work.

Water Supply

As the supply of fresh water near the site of the plant was very limited, a supply was obtained from Durant's Lake, four miles away. The company own the water rights. The level of this lake is about 500 feet above the level of the site of the plant, and at its outlet a timber crib, earth filled dam 12 feet high, with ample spillway capacity is provided. The pipe line for the distance of two miles from the dam, is a steel pipe 6 inches in diameter, and for the remaining two miles it is 4 inches in diameter. This water is delivered at the site of the plant into a 50,000 gallon wooden tank 24 feet in internal diameter, and 16 feet high.

Wharf

For the purpose of reducing the cost of handling oil for use in the plant, a wharf was built at Brentwood Bay for berthing the tank steamer and pumping the oil direct into the oil tanks. This wharf is of "L" shape, and is 250 feet long. It is constructed of ordinary round timber piles, and it was thought inadvisable at the present time to incur any heavy expenditure for creosoted, turpentine, or reinforced concrete piles, as a certain amount of leakage of oil is bound to take place around the wharf, and it is believed that this will have a tendency to prolong its life. The wharf was built by Mr. E. R. Doe, contractor, Victoria, and the largest oil tank steamer can be unloaded at any stage of the tide.

Switching Equipment

The generators and motor generators are connected to the 2,300 volt bus bars through a flexible system of switches, so that any piece of apparatus can, if necessary, be isolated from the rest of the plant. These switches are controlled from a black slate switchboard placed on a gallery in the annex west of the turbine room.

In the h.t. switch room, necessary switches for controlling the following h.t. lines are provided: (one) 3-phase, 60,000 volt, incoming line from Jordan River plant; (two) 3-phase, 60,000 volt, outgoing lines to Rock Bay sub-station, Victoria; (one) 3-phase, 60,000 volt, outgoing line to the Tod Inlet Cement Works and the Bamberton Cement Works. Each of these circuits is protected by means of aluminium cell lightning arresters.

The necessary switches are also provided for the following feeders:—two 3-phase, 11,000 volt power feeders; two 600 volt d.c. interurban railway feeders. All of these switches are controlled from the 16-panel black slate switchboard from which the generator switches are operated. For this purpose, a 60-cell, 300 ampere storage battery is used. This battery will also supply current for emergency lights in the building. For motors, pumps, blowers, etc., used in the building, a 2,300 volt service bus is provided. It is protected

(Concluded on page 49)

Flashover of Insulators with Low Frequencies

By Mr. Andrew McNaughton, M. Sc.

When two electric charges are separated by an insulating material, or dielectric, certain conditions of molecular strain are set up. This stress condition in the insulator is conventionally represented by lines of dielectric flux, and the density or number of lines per unit area is taken as a measure of the intensity of the strain.

Most solid and liquid insulators conduct these flux lines considerably better than air, which is the standard against which others are compared. The ratio of the number of lines set up in an insulator to the number which would be set up in a similar air path, with the same applied voltage, is called the specific inductive capacity (s.i.c.). Fig. 1 shows the flux between two parallel plates when air is the insulator, and Fig. 2, when glass is the insulator. The particular sample of glass has a s.i.c. of 5.

While the voltage involved in each case is the same, the actual quantity of electricity corresponds to the number of lines, and is then five times as large per unit area in the case of glass, as in the case of the similar air condenser. That is, in addition to the number of lines of flux per unit area, the s.i.c. has got to be considered in calculating the stress.

$$\text{The stress} = \frac{\text{density of lines}}{\text{s. i. c.}}$$

Fig. 1b, shows the effect of doubling the distance between the electrodes without changing the applied voltage; the number of lines per unit area is reduced to one-half.

Fig. 3 shows the distribution of flux between two spheres.

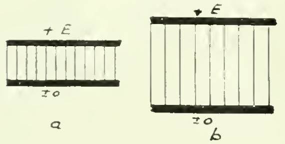


Fig. 1.

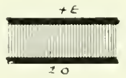


Fig. 2.

when the path is all air. Fig. 4 shows the flux when a plate of glass is inserted. Note that the actual density in the air film is considerably increased and the distribution slightly altered. That is, though we have inserted a very much stronger insulator in place of part of the air, we have increased the stress on the remainder. This may be shown experimentally as follows—Take two brass spheres 10-in. in diameter, separated about 1-in., apply a voltage and raise it until the air breaks down; this occurs at about 50,000 volts. Now, after taking the voltage off and inserting a plate of glass, again raise the voltage and sparks occur which cross the air film and flash around the glass, the whole combination breaking down at 40,000 volts, which is 20 per cent. less than in the previous case.

Fig. 5 shows the flux between two metal electrodes, on the same side of a sheet of glass. (a) Is an elevation showing the flux in the air and glass; (b) is a traverse section in the air path; (c) is a similar section in the glass just below the surface. The distribution of flux is very similar in the two sections; but the density is very much greater within the glass. Note that very few lines which originate in the air, pass into the glass.

Fig. 6 shows the flux when the electrodes are on opposite sides of the glass plate. In this case most of the flux has got to traverse both an air and a glass path.

Now in making a flash-over test on a sheet of glass with an arrangement of electrodes similar to Fig. 5, we find that it requires 80,000 volts to cause a spark between the electrodes; and further we note that the spark is in the air, not over the glass. In this arrangement the air and the glass paths are in parallel and little alteration in the stress distribution is caused by the insertion of the glass. On the other hand if we use an arrangement of electrodes similar to Fig. 6, sparks begin to spread out over the surface of the

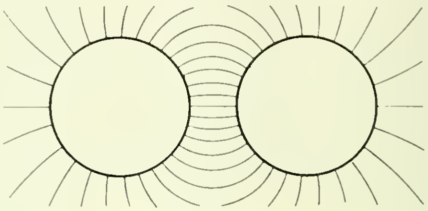


Fig. 3.

glass at a voltage of 30,000; at 50,000 volts flash-over around the surface occurs. In this case the glass and the air paths are in series, and a condition similar to Fig. 4 is established, when the weaker material is called upon to withstand nearly the whole stress.

It is interesting to compare the flashing distances and voltages in the two following cases:—

	Distance	Voltage	Volts per inch.
Fig. 5	8 inches	80,000	10,000
Fig. 6	25 inches	50,000	2,000

The electric streamers which spread out over the surface have the effect of increasing the size of the metal electrodes.

Fig. 7a shows the stress distribution when one of the electrodes is a needle point. In this case, as the voltage is raised, the surface is flooded with streamers, or corona, and the effective area of the electrode is increased and the local concentration of stress disappears as shown in Fig. 7b.

Fig. 8 shows the effect of placing wax around the needle to prevent the formation of corona. With this arrangement we find that the sheet of glass is punctured by the application of only 40,000 volts, which is 20 per cent. less than that causing flash-over without the wax.

From observation of these simple experiments we see that the fundamental condition which must be fulfilled to

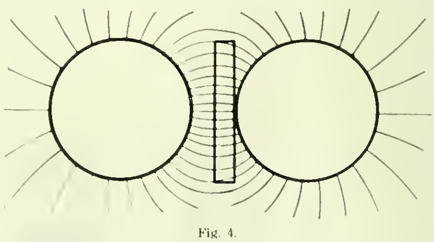


Fig. 4.

give the maximum flashing voltage between two electrodes is to prevent the concentration of the electro-static flux.

Concentration of flux is caused by:—(1) sharp electrodes, (2) paths of high and low s.i.c. in series; so that, in an insulator, the metal parts should be smooth and carefully rounded and the disposition of the porcelain, or glass, should

be parallel to, rather than across, the direction of electric stress.

Now, with regard to the measurement of the voltage, the ordinary voltmeters are only suitable for up to about 550 volts. Above that it is necessary to use either potential transformers or electro-static voltmeters, or, better still, some form of spark gap. In actual testing, the spark gaps have the advantage in that they show the presence of any abnormal wave form, while the voltmeters, either electro-static or electro-magnetic in conjunction with potential transformers, indicate merely the "mean effective value." The breakdown of an insulator of course depends on the "maximum value," rather than on the "mean effective value" of the voltage wave, though for convenience we usually refer insulation tests to the "Mean effective value" of a simple wave having the same maximum.

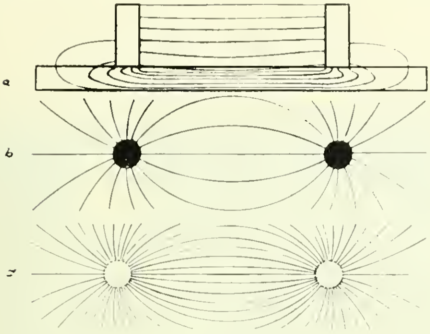


Fig. 5.

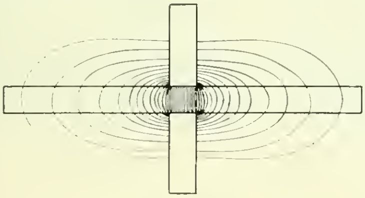


Fig. 6.

Fig. 9 shows the relation of sparking voltage to separation of electrodes, in the case of two needle points. Fig. 10 shows the same relation for spheres 10-in. (25 cms.) in diameter.

The effect on the electric field distribution of neighboring conductors is such as to cause the needle gap to be unreliable, unless it is removed from extraneous objects by a distance equal to at least twice the length of the gap. Thus for high voltages the needle gap occupies a lot of space and is rather inconvenient to use. At voltages below 50,000 it is very convenient and rather more accurate results can be obtained with it than with the sphere gap. As an example, set the sphere gap for about 200 kilovolts and adjust the needle gap to flash over at about the same voltage. In this way you can compare the sparks in the two cases.

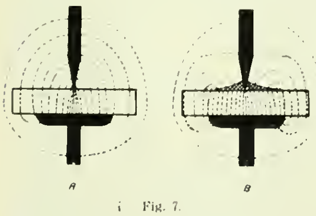


Fig. 7.

Fig. 8.

To prevent the formation of a power arc, we connect, in series, a water tube resistor of about one ohm per volt. With the spheres, the first sign of distress is the complete arc over. With the needles, a glow is established at a comparatively low voltage; this glow, or corona, gradually builds out as the voltage is increased until arc-over results.

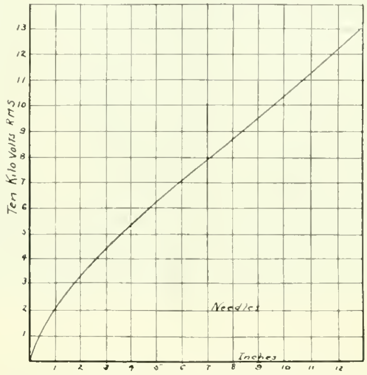


Fig. 9.

In order to obtain accurate results, both the needle points and the sphere distances, d, must be corrected for the density of the air by the following factor:—$d = 3.92b/(273 + t)$, where b = barometer in centimeters of mercury and t = degrees centigrade. Figs. 9 and 10 are drawn for 25 deg. C. and 76 cms. barometer pressure.

Smoke, water vapor, dust, etc., in the air have little effect on the sphere gap but the corona of the needle gap is very sensitive to them and errors of a magnitude of about 15 per cent. are liable to arise from these sources.

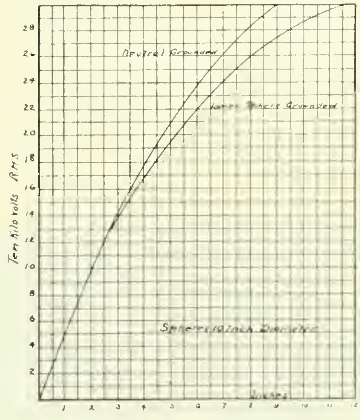


Fig. 10.

The effect of electric stress on the air is so important that an understanding of the mechanism of break down is essential. According to the almost universally accepted Ionic Theory, in addition to the molecules of the gases which go to make it up, the air always contains a number of ions, or infinitely small electrically-charged particles. When the

air between two electrodes is subjected to a difference of electric potential, the negatively charged ions are attracted to the positive electrode and the positively charged ions to the negative electrode and the ions get an acceleration proportional to the strength of the field. If now the field is strong enough and the distances between molecules of the air long enough, the ions acquire such a velocity that when

Fig. 12.

Fig. 13.

Fig. 14.

they strike a molecule the kinetic energy of the ion, which is then liberated, is sufficient to break up the molecule into other ions. This action is cumulative, and the air between the electrodes becomes filled with positively charged particles which carry electricity from one electrode to the other.

As soon as the electro-static field at any point is strong enough to cause ionization by collision, the air at that point begins to glow due to the vibration set up by the collision of the ions and the molecules. This glow is called the electric corona.

In the ease of parallel cylinders, where the air between two electrodes is stressed, the corona is first seen at the surface of the wires because, as shown by the curve in that ease, the strain in the air is a maximum at the surface of the wire and drops to such a value between the wires that the ions no longer get the necessary acceleration to enable them to reach the velocity at which ionization by collision begins. The fact that ionization by collision, and corona, begin at the same time, and that this time also is that at which the discharge becomes audible, is evident by observation of this experiment.

When the number of ions moving about between the conductors exceeds a certain limiting value, the tendency is for them to come together into a single path which is visible as a spark. If you examine the corona closely you see that the glow is traversed by minute thread-like sparks.

Examination of the formulae used in correcting the values of voltage read from the needle or sphere gap curve shows that at high temperature it takes a relatively low voltage to break down air. Now the spark represents dissipation of energy in the form of heat and so causes a rise in temperature of the surrounding air; hence, when the spark extends clear across from one terminal to the other, the energy may be so great that the air remains broken

Fig. 17.

Fig. 18.

down and a so-called power arc is developed. Due to the relatively slow rate at which the heat is dissipated from the over-heated air, this arc is able to re-form on the peak of the succeeding wave along more or less the same paths as followed in the previous cycle. Fig. 12 shows an arc of this nature occurring over an insulator. Notice the gradual drift upwards. The frequency in this case was about 250 cycles.

Other photographs reproduced herewith show the flash-over of insulators of various size and materials, designed for various line voltages. The Pin Type was tested with both wooden and metallic pin, but using a wooden pin, a materially higher voltage for flash-over and a quite different performance is observed.

The flash-over of a suspension insulator (dry) with suc-

Fig. 15.

Fig. 16.

Fig. 19.

Fig. 20.

cessively increasing number of units in the string gives approximately the following results:

Sections	Voltage	Increase
1	80,000	.....
2	145,000	65,000
3	190,000	45,000
4	220,000	30,000
5	235,000	15,000

The same 5 section unit tested under rain conditions gave a flash-over value of about 200,000 volts.

Fig. 13 shows corona and streamers during test of a four section suspension unit, dry. Fig. 14 shows a power arc with the same unit. Fig. 15 shows corona and streamers with a two section suspension unit, dry. Fig. 16 shows a change of streamers to power arc at a slightly higher voltage. Fig. 17 is a photograph of the corona and streamers on a two section suspension unit under rain test; note that the path is over the surface of the insulator. Fig. 18 represents a change of streamers, with the same unit, to a power arc. Fig. 19 represents a test on a pin type unit with metal pin. Fig. 20 is the same unit under rain test. Fig. 21 shows corona and streamers when using a pin type unit with wooden pin, rain test. Fig. 22 shows a power arc under the same conditions.

Fig. 21.

Fig. 22.

(Continued from page 45)

from the main bus by an oil switch of high breaking capacity. The service feeder oil switches are hand operated.

Active construction work was commenced on the 1st of June, 1912, and the first of the two 2,000 kw. turbo-generators was put in service on the 20th of November of that year. The second 2,000 kw. turbo-generator was started up four days later, and since that date the plant has been in operation as an auxiliary without any trouble whatsoever.

As previously stated, the contractors for the work were Messrs. C. C. Moore & Company, of San Francisco, who are to be congratulated on the very successful and expeditious way in which they carried out the work. Mr. C. R. Weymouth is chief engineer of the company, and Mr. J. H. Hopps and Mr. J. R. Atchison represented the contractors on the ground. The work was under the general direction of Mr. G. R. G. Conway, M. Inst. C. E., chief engineer of the British Columbia Electric Railway Company, Limited, assisted by Mr. W. V. Hunt, electrical engineer, and Mr. G. M. Tripp, engineering superintendent, Victoria, both of the British Columbia Electric Railway Company.

High Voltage Systems

The Electrical World has just issued a compilation covering the details of the transmission systems of the world operating at and above 70,000 volts. Perhaps nothing indicates better the rapid advance being made in the electrical industry during the last five years than this list of 54 high tension systems. As an item of interest we give below the names of the companies, the operating voltages, the frequency and their present capacity rating.

Pacific Light & Power Co.	150,000	50	59,500
Au Sable Electric Co.	140,000	60	19,000
Southern Sierras Power Co.	140,000	60	8,750
Utah Power & Light Co.	100,000	60	33,000
Pacific Gas & Electric Co., 125,000 to	110,000	60	25,000
W. Penn. Trac. & Water Power Co.	125,000	60	32,000
Tennessee Power Company	120,000	60	15,000
Connecticut River Transmission Co.	120,000	60	14,400
Inawashiro Hydro-electric Power Co.	115,000	50	42,000
Au Sable Electric Company	110,000	30	9,000
Hydro-electric Power Commission of Ontario	110,000	25	106,800
Lauchhammer, A. G.	110,000	50	15,000
Georgia Railway & Power Co.	110,000	60	50,000
Alabama Power Company	110,000	60	48,000
Mississippi River Power Company	110,000	25	112,500
Lehigh Navigation Electric Co.	110,000	25	30,000
Cedar Rapids Mfg. & Power Co.	110,000	60	90,000
Mexican Northern Power Co.	110,000	60	26,000
Ebro Irrigation & Power Co., Ltd.	110,000	50	50,000
Chile Exploration Company	110,000	50	40,000
Sierra Electric Power Company	110,000	..	.....
Sierra & San Francisco Power Co.	104,000	60	34,000
Great Falls Power Co.	102,000	60	21,000
Yadkin River Power Company	100,000	60	24,000
Colorado Power Company	100,000	60	10,000
Great Western Power Company	100,000	60	50,000
Southern Power Company	100,000	60	75,000
Shawinigan Water & Power Co.	100,000	60	45,000
Los Angeles Aqueduct	100,000	50	22,500
Tata Hydro-electric Company	100,000	50	40,000
Pfalzwerke, A. G.	100,000	50	10,000
Societa Italiana di Elettrochimica	88,000	42	23,280
Appalachian Power Company	88,000	60	20,610
Rio Janeiro Tramway, Light & Power Company	88,000	50	48,800
Sao Paulo Electric Company	88,000	60	30,000
Tasmania Hydro-electric & Metal Co.	88,000	50	.....
Mexican Light & Power Co.	85,000	50	58,500
Toronto Power Company	85,000	25	80,000
Victoria Falls & Transvaal Power Co.	84,000	50	40,667
Northern Power Company	80,000	60	.....
Energia Electrica de Cataluna	80,000	..	.....
Swedish State Railways	80,000	15	26,400
Katsuragawa Denryoku Kabushiki Kaisha	77,000	50	22,400
Southern California Edison Company	75,000	50	20,000
Au Sable Electric Company	72,000	30	3,000
City of Milan	72,000	42	21,000
Societa Generale Elettrica dell'Adamello	72,000	42	45,000
Montana Company	70,000	60	21,500
Hidroelectrica Espanola Molinar	70,000	50	27,000
Pennsylvania Water & Power Co.	70,000	25	71,500
Guadalajara, Mexico	70,000	50	8,000
Societa Elettrica Riviera di Ponente.	70.000	50 & 16 2/3	27,000
Swedish State Railways	70,000	25	17,600
City of Winnipeg ... 66.000 to	72.000	60	15,000

Electrical Drive of Winding Engines and Rolling Mills

By C. Antony Ablett, A. M. Inst. C. E., and H. M. Lyons, A. M. I. E. E. (Continued)

Power Diagram of Three-Phase Winder

Where the speed of a three-phase induction motor is controlled by placing resistances in the rotor circuit, and the motor is giving a definite turning moment, the same amount of power will be taken from the supply system whatever the speed of the motor may be. The turning moment multiplied by the speed gives the amount of power which the motor uses and the remainder of the power is wasted in the resistances. Thus, the three-phase motor involves great waste of power.

Fig. 4 is a power diagram for a three-phase winder with a cylindrical drum winding at the rate of 270 tons per hour from a shaft 1,600 feet deep, the maximum speed being 40 feet per second. The shaded portions of this diagram represent the power which is wasted in the resistances of the starter in starting and stopping the motor, and in this particular case the useful work done by the winder is 524 horse power minutes per wind. The amount of energy wasted in the starter is 325 horse power minutes per wind. Taking into account the efficiency of the three-phase motor the energy taken by the winder from the supply system is 910 horse power minutes per wind. The average efficiency of the electrical plant, therefore, is only 57.5 per cent.

Comparison of Three-Phase Winder with Ward Leonard and Ilgner Winders

Fig. 4 shows how large the power losses are in starting and stopping a three-phase winder. It also illustrates a case that is much more suitable for a Ward Leonard or Ilgner winder than a three-phase winder, and as the loss in starting and stopping a three-phase winder is very great, it will be seen that it is most advantageous to employ a three-phase winder where the starting and stopping is infrequent, and where there is a long run at full speed, when the three-phase winder is economical, or where there is a considerable interval between winds. These are practically the conditions of a long slope haulage.

Under such conditions a three-phase winder can easily prove more economical in power than the Ilgner or the Ward Leonard winder, because, with the latter, the motor-generator set would have to be kept running continuously and this involves an unceasing though small expenditure of power, so that the energy taken to run the motor generator set can easily be more than the energy wasted in starting and stopping the three-phase winder.

The three-phase winder is advantageous:—

(1) Where the capital cost of the plant is a prime consideration, as the total cost of the three-phase winder is from 20 per cent. to 35 per cent. lower than that of a Ward Leonard winder.

(2) Where the starting and stopping is infrequent and long runs at full speed are required, as is particularly the case with slope haulage.

Lowering Load

There are three methods by which the load can be lowered with a three-phase winder:—

(1) By controlling the speed with the mechanical brakes.

(2) By lowering at such a speed that the motor is run above its synchronous speed and so acts as a generator and returns power to the supply system.

(3) By reversing the connections to the motor so that it is giving its turning moment in the reverse direction to the rotation, and controlling the speed by the use of the ordinary control lever with reverse current.

The third method by which the connections of the motor are reversed, so that it is exerting its torque against the rotation, is extremely wasteful, because the motor takes power from the line in proportion to the turning moment which it is exerting, as well as the power which is given out by the winder, corresponding to the work done by the loads in descending.

As an example of this attention may be called to the lowering diagram, with reverse current, shown in Fig. 5 The amount of energy given up by the lowering of the load is 20,900 horse power seconds. The amount of energy taken by the motor from the supply is 42,900 horse power seconds.

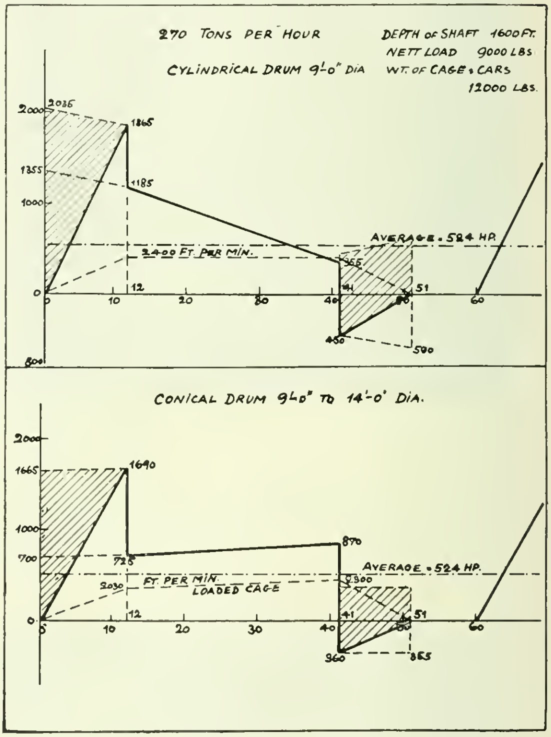


Fig. 4.

Therefore, in order to exert the braking effect on the winder, and to absorb the power given up in lowering the load, which amounts to 20,900 horse power seconds, the starter has to dissipate 63,800 horse power seconds.

It will easily be seen, therefore, that when a load is lowered in this manner, the amount of energy which the starter has to dissipate is very large, and in order to enable lowering to be carried out in this way it would, in many cases, be necessary to employ a much larger starter than is required for controlling the winding engine when hoisting.

This method of lowering is the easiest to control, and, for this reason, although it is very wasteful, it is generally adopted for large three-phase winders.

Emergency Gear

A three-phase wnding engine is provided with a mechanical brake, which is brought into action by means of a weight attached to a lever, but the brake is normally held away from the brake drum by air pressure. If this air pressure fails, then the weight brings the brake on to the brake drum and stops the winder. As the speed of a three-phase winder for a given position of the control lever depends on the load which is being hoisted, it is not possible to provide cams on the depth indicator in order to slow down the cage before it reaches the bank. The proper slowing down of the cage depends on the skill of the driver, but an overhead device is fitted both in the shaft and on the depth indicator, and in case the cage over-runs the bank cuts off the power from the motor and applies the brake by means of the emergency gear.

An emergency lever is provided on the driver's platform by which he can cut off the power and apply the brake,

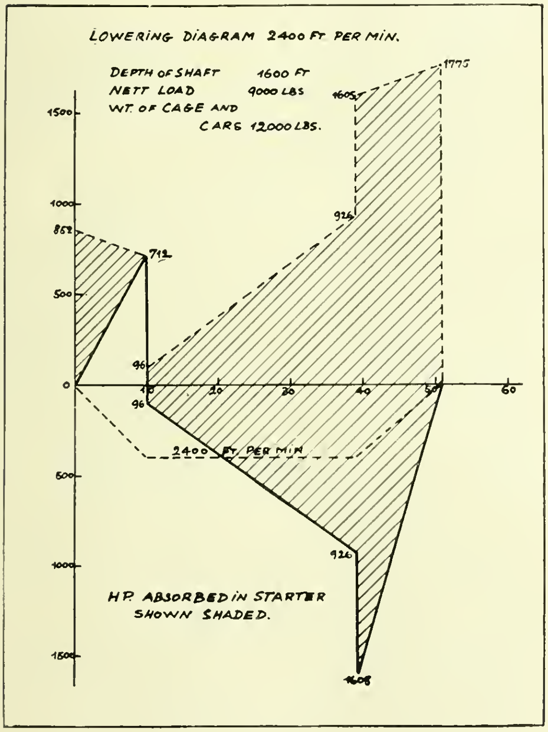


Fig. 5.

stopping the winder immediately in case of necessity. In case the power supply fails the brake is at once applied through the emergency gear.

Winding Men

With the three-phase winder the speed for winding men cannot be limited automatically, as in the case of a Ward Leonard winder, and the speed depends entirely on the skill of the driver.

General Conclusions Concerning Winding

Generally speaking, the authors are of opinion that the Ward Leonard or Ilgner system of electric winding is the most suitable for vertical shafts, and for all cases where large outputs are required and short and frequent winds are made.

The three-phase winder always has the disadvantage that it cannot be so completely protected against careless handling as either the Ward Leonard or the Ilgner, but it may prove more economical for long slopes where the full speed run is a long one and the periods of acceleration are comparatively infrequent.

Regarding the choice of drums for the winding engine, the authors are of opinion that in many cases where electrical drive is adopted, the cylindrical drum winder will prove the most suitable, but that in cases of deep shafts where the winding speed is high the scroll drum winder may prove better than the cylindrical drum winder, but that the field of application of the conical drum winder to electric winding is very small.

The authors have purposely avoided any comparison between the running costs of a steam and an electrically-driven hoist or rolling mill, because each case should be considered on its own merits and comparisons made for one case will not be valid for another where conditions are different. No general comparison has any practical value, sometimes the steam engine is the more economical, and sometimes the electrical plant, according to conditions, and in deciding which is the more advantageous there are other factors besides running costs to be considered.

As, however, the authors wish to see a fair comparison made in every case they should draw attention to a very fallacious method sometimes used for establishing the running cost of a steam engine, namely, either indicating the engine or measuring the water rate over an hour or two when the engine is running under the most favorable conditions, and establishing the yearly running costs from these. If tests are carried out over a prolonged period, say several months, a much higher running cost will be obtained, in some cases half as much again, as the standby losses of a steam plant are very considerable, much higher in proportion than those of an electrical plant.

ELECTRIC DRIVING OF NON-REVERSING MILLS

For the driving of a non-reversing mill, that is to say, a two-high, three-high, or double-two-high mill, a flywheel is nearly always used in conjunction with the motor, so that the flywheel assists the motor in providing large powers necessary during the passes, when a bar is going through the rolls, thus enabling a smaller motor to be used than would be required if no flywheel were employed, and reducing the variation in power taken from the supply system.

The motor and flywheel may be either direct coupled to the mill pinions, or the flywheel may be coupled to the mill pinions and a high speed motor provided which drives the flywheel shaft through a gear, rope or belt drive, and in the case of a rope or belt drive, the flywheel itself is often made the large pulley.

There are such great advantages in driving a mill by a direct coupled motor and flywheel, that this method has been adopted in a great many instances, and it may be shown that even for a sheet mill running at so slow a speed as 28 to 30 r.p.m., there are very great advantages in employing a direct coupled motor and flywheel in spite of the high capital cost, which has led to this direct coupled drive being adopted for a number of sheet and tin-plate mills.

Where a high-speed motor is installed, the flywheel should always be coupled to the mill pinions, for it is a bad practice to install a high speed flywheel coupled to the shaft of the high speed motor, because the stresses due to the power given up by the flywheel are undetermined, as these depend on the rate of deceleration of the flywheel, and if these stresses had to be transmitted through gears, ropes or belts, they either have to be designed with a very large margin of safety, or else they are liable to be unduly stressed and suffer damage. It is always a good principle to couple

the flywheel to the mill pinions in as direct a manner as is possible.

To enable the flywheel to assist the motor by giving up some of its stored kinetic energy so as to provide part of the power required during the passes, provision must be made so that the motor and flywheel fall in speed as the power required increases, that is to say, the motor must be artificially made to decrease in speed to a considerably greater extent than it normally would with an increase in power. This artificial increase of the fall of speed can be obtained by either of two methods:—

(1) By arranging that the speed shall steadily decrease as the power given by the motor increases. Where the mill motor is a direct current motor, this is done by providing the motor with a compound winding, which causes the necessary fall in speed without loss in power.

Where a three-phase mill motor is installed, resistances must be inserted in the rotor circuit, which cause a definite loss in power as the speed decreases.

(2) By arranging that the speed shall commence to decrease after the motor has reached a predetermined load. This is done by introducing some electro-mechanically operated device, such as a relay, which diminishes the resistance in the shunt field of a direct current mill motor when a predetermined load is reached, or a relay, which in the case of

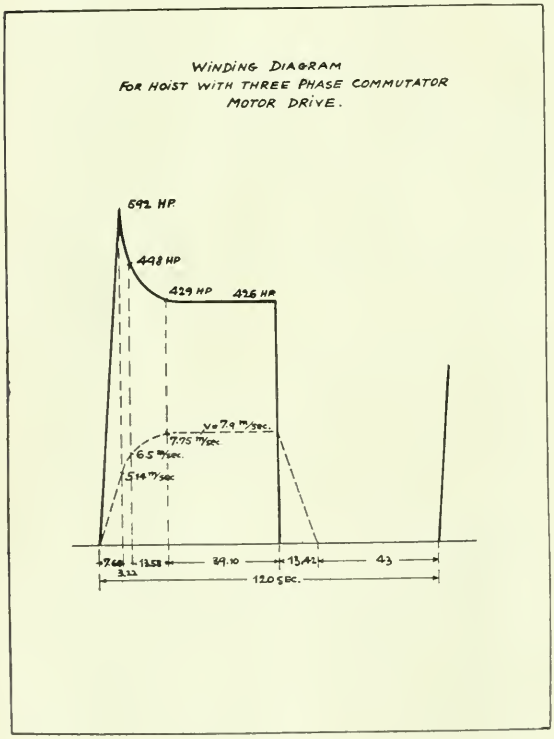


Fig. 6.

a three-phase motor, increases the resistance in the rotor circuit.

This second method of artificially increasing the fall in speed or slip is often spoken of as automatic slip regulation, but the term "automatic" is a misleading one, because both methods are automatic, and it would be more correct to call the first method "permanent slip regulation," and the second "intermittent slip regulation."

Speed Variation

In Europe the ordinary three-high merchant mill with roll diameters ranging from 10 in. to 18 in. is required to roll as many different sections as possible to meet the conditions of trade, and the smaller mills have to roll sections from either steel billets, scrap piles or puddled iron bars.

To meet these conditions such mills have to be able to run at a considerable number of different speeds.

It is always desirable to run at as high a speed as possible to get large outputs, but it is not possible to roll large steel billets at as high a speed as small billets, for it would be a physical impossibility for the men to catch a large and heavy steel billet thrown from the first pass of the roughing mill at a high speed.

Iron must be rolled at a much slower speed than steel, for if iron bars are rolled at a high speed they would be torn up and spoiled.

Guide rounds or squares can be rolled at a much higher speed than hand rounds or squares, for where guides can be used they hold the bar in position, but in rolling hand rounds the roller has to hold the bar in position with his tongs, and the speed of rolling must not be faster than he can walk or else he cannot follow up the bar.

The conditions for driving such a mill are very well fulfilled by the direct current compound wound compensated motor, because it can be set to run at any basis speed suitable to the section being rolled by regulating the shunt field, while the compound winding acts as a permanent slip regulator, and gives the necessary fall in speed, without wasting power, to enable the flywheel to give up part of its stored energy to assist the mill motor when required.

When the billet is out of the rolls the mill motor will not run above the basis speed to which it has been set, so that there is no difficulty in entering the next billet.

The three-phase induction motor is not at all well suited for driving such merchant mills, because its speed can only be reduced to that suited to the section being rolled by inserting resistances in the rotor circuit, and attention has already been called in the three-phase winding engine section of this paper to the great variation of speed which takes place with change of load, when the speed of such a motor is reduced in this way.

Suppose that the mill quoted under example 1 were driven by a three-phase induction motor having a synchronous speed of 250 r.p.m., and, in order to roll large billets, such resistance was inserted in the rotor circuit to bring down the speed to 120 r.p.m. at a definite load. As soon as the bar was out of the rolls the motor would speed up, and, if the interval before the bar was re-entered was at all long, the speed of the motor would be nearly up to 250 r.p.m., so that it would be very difficult to re-enter the bar, and to re-enter a fresh billet at this speed would be almost impossible, as the rolls running at such a high speed would not grip the large billet. A mill driven in this way would be practically unworkable.

Suppose the motor were a 500 h.p. motor, then, if the speed were reduced to this extent, about 250 horse power would be wasted in the resistance if the motor was giving the turning moment corresponding to its full load. Such a three-phase drive is also extremely wasteful.

The most successful method of utilizing three-phase current to drive merchant mills working under such conditions which has yet been devised, consists in installing a three-phase motor direct coupled to a smaller compound wound direct current motor for driving the mill and providing a rotary converter having its sliprings connected to the sliprings of the rotor of the three-phase motor and its commu-

tator connected to the commutator of the direct current motor. When it is desired to run this mill motor combination at speeds below synchronous speed, the power which would otherwise be lost in resistance in the rotor circuit for the three-phase motor is converted from three-phase to direct by the rotary converter and beneficially used in the direct current motor to assist the three-phase motor in driving the mill.

This system is therefore economical and the three machines together behave something like a direct current compound wound motor. That is to say, the mill motor set can be adjusted to run at any basis speed suitable to the section being rolled by regulating the shunt field of the direct current motor, while the compound winding of this direct current motor acts as a permanent slip regulator, giving the necessary fall in speed to allow the flywheel to take effect, without entailing any loss in power.

It will also be seen that, when the bar is out of the rolls, this set will not speed up to the synchronous speed, but will be limited by the basis speed to which the direct current motor has been set. Such variable three-phase sets have been installed for driving 8 or 9 different merchant mills, with very good results, the largest being a 1,300 h.p. set, and it is quite easy to obtain a 3 to 1 speed regulation, economically, in this way, and to get any speed at all, within these limits, while the turning moment which the set can give, increases as the speed is reduced.

CONCLUSIONS CONCERNING ROLLING MILLS

The authors are of opinion that direct current is much better adapted for driving mills and machinery in a steel works than three-phase current.

Where large reversing rolling mills are driven electrically, and the motor driving the motor generator set is supplied from a direct current system, it is found that the power supplied to the rolling mill plant can be maintained at a much steadier value than if it is supplied from a three-phase system, and with the direct current motor about a ten per cent. saving in power can be effected, as there is no loss of power in slip resistances.

With a direct current system the flywheel of the motor generator set can be utilized to a great extent for neutralizing sudden peaks of short duration in the power demand on other parts of the system, for, during such a peak, the motor generator set would not only cease to take power from the supply, but the motor can be actually reversed, and give its full output as a generator returning the energy of the flywheel as electrical energy to the supply system.

With a three-phase system, peaks in other parts of the system cannot be neutralized to anything like the same extent, for the motor can only be made to cease to take power from the supply system and cannot act as a generator returning power to the supply system.

It has been shown that the direct current compound wound motor is very well adapted to fulfil the conditions for driving three-high merchant and bar mills and that considerable complication and difficulties are involved in adapting the three-phase motor for this purpose.

Direct current motors are also particularly well adapted for driving slow speed sheet and tinplate mills, as it is very easy to provide a slow speed direct coupled motor and gain the advantage and economy of this drive, and, as there is no loss of power in slip resistances, the direct current motor will prove from twelve to fifteen per cent. more economical than the three-phase motor on this current alone.

The advantages of direct current table and live roll motors are so fully recognized that they need not be recapitulated here, but it is interesting to note that in perhaps the largest steel works on the American Continent, where the main power supply is three-phase, all the table motors are direct current and a large and costly installation of converting machinery has been provided to convert the three-phase current to direct current to supply these table motors.

It may be argued that the cost of cables with a 500 volt direct current system is much higher than for a high voltage three-phase system, but it must be remembered that a well laid out steel works is comparatively compact and the distances are relatively short, so that the cost of cables is not a very serious item, and that the additional capital cost of a three-phase generating plant to produce power, which is wasted in the slip resistance, etc., will pay for a good deal of extra cable.

In steel works where there are blast furnaces and coke ovens, the modern tendency is to instal large gas engines

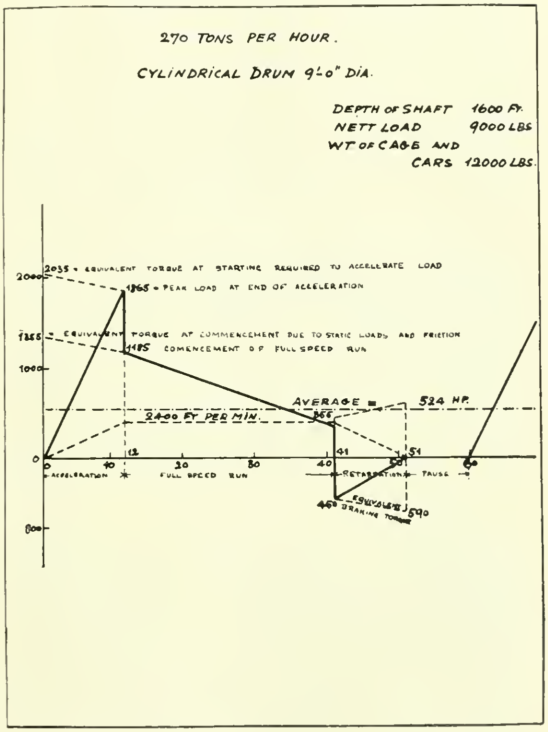


Fig. 7.

using blast furnace or coke oven gas, both for driving the blast furnace blowers and for generating electrical power, and experience shows that a direct current gas engine power house is cheaper in capital cost and easier to operate than a three-phase power house.

Gas engine driven three-phase alternators present the most difficult problem in parallel running, and while sufficient experience has been gained in the past ten years to enable these difficulties to be overcome by proper design, the provision of very heavy flywheels is always necessary, and these largely increase the capital cost of the three-phase generators, which are intrinsically more expensive than direct current generators. The higher the periodicity the heavier the flywheels for the three-phase generators become. The 500 volt direct current system has found very wide application in the steel works on the continent of Europe.

Electric Railways

The Development of Electric Traction

By John R. Hewett*

The steam railroad is just about a century old and the electric railway about a quarter as old, and when we think of the astounding developments that have taken place in this comparatively short space of time, we can hardly refrain from asking ourselves why this development has come about. The answer to this question would seem to be that the civilization of the world is absolutely dependent upon rapid communication between man and man—the communication of thoughts and of material matter. The invention of the steam engine and locomotive pointed the way and then, with the introduction of the electric telegraph and the submarine cable, the different peoples of the world became so much more closely connected in thought that the general extension of a more rapid means of physical communication seemed imperative. The stage coach on land and the sailing ships on the seas had to be replaced by quicker methods of communication. It was about the beginning of the nineteenth century that people began to recognize that the country which developed the best means of rapid communication with other countries would be the leader in the commerce of the world—those that had most ships would control the seas and the markets of the world; and, similarly, that it was only those countries that developed an efficient system of land transportation that could develop their natural resources and consequently become manufacturing countries.

The recognition of these great economic truths came about just at a time when the whole world had been well nigh torn asunder and rent by a series of wasteful and disastrous wars. In looking back at the history of this period, the development seems miraculous. All sections of the civilized world would seem to have taken on a new form of life, and commerce became to be recognized as a better trade than war. The development of better means of communication aided the rapid spread of civilization and the spread of civilization stimulated industrial developments of all kinds. Thus was started an action and a reaction which has been continued up to the present time, with the result that to-day a man living in New York knows more about the capitals of China and Japan than his grandfather knew about many towns scarcely a hundred miles from his own door, and that each of us individually to-day are virutally in connection with the whole rest of the world. It is easier to make a trip around the entire globe to-day, in comfort and in luxury, than it was to travel from one end of New York State to the other, at the cost of hardships and dangers, a hundred years ago.

These developments have absolutely changed our modes of living and during the transition stage one thing of vital importance has happened, viz., we have let these means of communication become our masters as well as our servants. When we stop to consider the enormous populations congested into our large cities, and the distances from which their daily food supplies have to be transported, it is apparent that our means of communication are the masters of the situation. Should they for any reason fail to fulfill their functions in the community for even a brief time, it would spell death by starvation to hundreds and thousands of human beings.

So in this brief period of one century we have built up a set of conditions that has so complicated our modes of living and increased our dependence on the labors of others, living at a great distance from us, that now our transportation facilities have become just as much one of the necessities of life as are food and clothing. The character of our transportation systems has thus become a matter of national importance.

It was long after this civilizing movement had set in and become well established that the electric railway made its appearance. In fact, it is just about twenty-five years ago that Sprague, Van Depoele, Daft and Bentley-Knight, amongst other energetic pioneers in the industry in this country, began to show the possibilities of this new mode of traction. In this short space of time electric traction has not only become well established, but has grown to be one of the most important industries in the country. In the last twenty-five years electric traction has, practically speaking, superseded all modes of transportation for city, suburban and interurban service, including elevated railways and subways. A whole paper could be written with profit to show the advances that have been brought about in our social status by the electric railway. There are few who realize how much the public and especially those interested in real estate have benefited by the enterprise of those who have been responsible for the building of our electric railway systems, but we have not time to go into this phase of the subject here.

The field is broad

It seems to-day that the field for electric traction is as broad as the traction field—that is to say, that it has been developed to a stage where there are no longer any technical limitations to its adoption on every railroad in the country. The traffic could be handled electrically and the considerations which govern the choice between steam and electric traction are financial and economic, not technical. Within the last decade, we have seen many notable examples of the electrification of steam railroads, and judging by the general interest that has been awakened in railroad circles and the recognition of the splendid service being performed by those electric installations already made and the economies secured by their adoption, we shall see many more examples of steam railroads adopting electric traction during the next decade.

All modes of traction depend primarily upon energy, and whether steam or electric traction ultimately becomes universal depends upon the relative economic values of the form of energy used. It should be noted here that of all the forms of energy available, only two are generally considered for traction purposes, viz., the chemical energy stored in coal and electric energy. Dr. Steinmetz in a paper be-

*General Electric Review.

fore the Franklin Institute has recently pointed out the reason for this, viz., because they are the only two forms of energy that can be economically transported or transmitted over long distances. The two following paragraphs are taken from Dr. Steinmetz's recent paper:

"Electrical energy can be transported or, as we usually call it, transmitted—economically over practically any distance. Mechanical energy can be transmitted over a limited distance only, by belt or rope drive, by compressed air, etc.; heat energy may be carried from a central steam heating plant for some hundred feet with moderate efficiency, but there are only two forms of energy which can be transmitted over practically any distance, that is, which in the distance of transmission are limited only by the economical consideration of a source of energy nearer at hand—electrical energy, and the chemical energy of fuel. These two forms of energy thus are the only competitors whenever energy is required at a place distant from any of Nature's stores of energy. Thus, when in the study of a problem of electric power transmission we consider whether it is more economical to transmit power electrically from the water power or the coal mine, or generate the power by a steam plant at the place of demand, both really are transmission problems, and the question is whether it is more economical to carry energy electrically over the transmission line, or to carry it chemically, as coal by the railroad train or boat, from the source of energy supply to the place of energy demand, where the energy is converted into the form required, as into mechanical energy by the electric motor or by steam boiler and engine or turbine.

"Electrical energy and chemical energy both share the simplicity and economy of transmission or transportation, but electric energy is vastly superior in the ease, simplicity, and efficiency of conversion into any other form of energy, while the conversion of the chemical energy of fuel into other forms of energy is difficult, requiring complicated plants and skilled attendants, and is so limited in efficiency as to make the chemical energy of fuel unavailable for all but very restricted uses: heating and the big, high-power steam plant. To appreciate the complexity of the conversion of the chemical energy of fuel, compared with the simplicity of electrical energy conversion, imagine the domestic fan motor with coal as source of energy; a small steam engine, with boiler and furnace, attached to the fan; to start the fan, we have to make a coal fire and raise steam to drive the engine. This illustrates how utterly unavailable the chemical energy of fuel is for general energy distribution. Generally energy distribution, therefore, may justly be said to date from the introduction of electric power."

From the foregoing it will be seen that electrical energy and the chemical energy stored in coal are the only two available sources of energy for traction purposes, and that in the case of coal we have to carry our fuel and generating apparatus adding enormously to the weight of the moving element and consequently to the cost of transportation, while in the case of electrical energy, there is no fuel or generating apparatus to be transported. This gives electric transportation a tremendous advantage, but at the same time it must be remembered that in the case of electric traction we have to provide the means for supplying the energy, which means the construction of a trolley system or third rail for the whole length of the line.

The general extension of hydro-electric developments which is fast covering the country with a network of high tension transmission lines is making a source of cheap energy available in many localities. This development will prove quite an asset to many roads who would rather buy than manufacture their own power.

In the case of electric traction, the range of energy suply is very flexible—we have the whole resources of the power house available—while with steam traction,, if we want excessive power for only a short distance we have to transport sufficient generating apparatus and fuel all the time we are working at light loads.

So the question of the electrification of steam railroads resolves itself to a question of whether it is cheaper to build a system for the distribution of energy for the whole length of the line than to carry the fuel and generating apparatus along with our freight and passenger trains.

This is absolutely a question of economies, and will be settled as such in each individual case after a careful analysis has been made of the individual requirements.

If the traffic was sufficiently dense, it would always pay to electrify a railroad, because the economies to be secured by electric operation would more than offset the interest to be paid on the initial expenditure, but where the traffic is scarce and the length of the line is long, that is to say, where the initial cost of electrification and the cost of operating and maintaining permanently an extensive system of energy distribution would be great, in comparison with the cost of hauling the fuel and generating apparatus along with the train, then steam traction is still the most economical.

We have many examples of steam railroads with dense traffic that have made or are contemplating the change from steam to electric traction to secure these economies, and also many special cases where electrification has come into being to secure some special economies or overcome some special conditions, such as the abatement of smoke in terminal stations, etc.

A difficult engineering problem

The analysis of operating conditions to determine whether it would be economical to electrify or to continue steam operation is becoming an important branch of the engineering profession. There are to-day many instances where electrification would pay, but where difficulty would be found in financing the undertaking. When some of the roads that are contemplating electrification have done so and have gained the experience from actual practice, it is likely that other roads will follow their example and that the electrification of our steam railroads will become one of the large electrical industries of the country.

When an analysis of the conditions in any particular instance has shown that electrification would be economical, we still have to determine which of the available systems of electrification is best suited to the requirements. This is purely a question of economics, and here again is the necessity for a careful analysis to determine the most economical way of distributing the expenditures to be made in the initial construction, the operation and the maintenance of the system.

For example, when the traffic is very dense, and where cars or trains of moderate size have to be run at very frequent intervals and the total energy used at any one instant is not very greatly in excess of the average load, then standard 600 volt apparatus has no equal. There is no objection to the heavy outlay in sub-station apparatus and feeder copper when such apparatus will be in operation at an efficient load factor for a good percentage of the twenty-four hours.

It is when the load is such that the cost of copper and of the machinery installed in the power house and sub-stations is excessive, and the percentage of time that they will be working at anything like an efficient load factor is small, that we look about for ways and means of reducing the amount of machinery necessary and of increasing the time that it will be in actual use. As a matter of fact, these conditions are just what exist on most systems where electrification is contemplated, and it is to meet such conditions and make electrification an economic possibility that the high

voltage systems, viz., the three-phase system, the single-phase alternating current system and the 1200 and 2400 volt direct current systems have been evolved; in other words, higher voltage is an economic necessity to avoid excessive expenditure in copper and in machinery which would only be working at part or no load for a great percentage of the working day.

The three-phase system has found but little favor up to the present in this country, while it has been very extensively adopted in Europe; but there is one case, viz., the electrification of the Cascade Division of the Great Northern Railway, where such a system has been in successful operation for some years in this country. It would seem in the light of our present knowledge that such a system, at least for conditions as they exist in this country, is likely to be confined to mountain grade work where the advantages of regeneration can be secured. On the other hand, as the high potential direct current system has been developed with these same features, there seems little to warrant the additional complication of the three-phase trolley.

During the last decade the relative merits of single-phase alternating current and high potential direct current systems have been freely discussed, and many examples of each system have been installed and have been operated for a sufficiently long period to enable a logical opinion to be formed as to their relative merits. It would be impossible to enter into a detailed discussion of this phase of the subject in a paper of this length, but judging from the results of operation, as published, and the number of single-phase interurban roads that have been changed from single-phase alternating current to direct current, and from the number of direct current roads now in successful operation, and the fact that no roads adopting higher direct current potential have changed, and the present ratio of alternating and direct current work now under construction and contemplated, it would seem safe to infer that at present, at least, the higher potential direct current road has a decided advantage over all other systems for heavy traction work.

What the future has in store no one can say. The alternating current system or some modification of it may be developed along lines that will enable advantage to be taken of its good features, and its inherent limitations to be overcome. And again, new modes of power transformation may come into use such as rectifying alternating current to direct when the advantages of the alternating current secondary distribution could be combined with the excellent characteristics of the direct current railway motor. But if we start speculating on the future, there is no limit to the range of our imagination.

No standard as yet

There has recently been said, both in the technical press and elsewhere, a great deal about what people are pleased to style "The Battle of the Systems." Some people have taken the attitude that electric railway developments have been hindered because all manufacturers of electrical apparatus are not agreed upon the best system for heavy traction purposes. Such people are prone to infer that such a condition of things is hindering development, and that the manufacturers are responsible for this condition. As a matter of fact, such differences of engineering judgment, when there are several different methods of attacking a problem, must, in the long run, be beneficial to the railroads rather than harmful, as without such differences of judgment, the possibilities of the art can at best be but imperfectly developed. When any art has been developed to a reasonable state of perfection and the fundamentals have been well considered and thoroughly tried, and after the process of eliminating the less suitable factors and perfecting those which have shown themselves capable of meeting the necessary demands, under actual service conditions, has been carried to the point where our knowledge, based on experience, enables us to retain the good and reject the bad, then and not until then, is the time to talk of standardization. An attempt at standardization when an art is in a more or less embryo state is likely to work a permanent harm inasmuch as it limits our knowledge of the broader engineering possibilities that might be brought to bear upon the subject. This question is of such importance to-day that it is worthy of consideration from both sides.

This so-called "battle of the systems" to-day is, as we all know, applied to heavy traction between single-phase and high voltage direct current. Briefly, there are two courses open: to attempt to standardize one, or to try both. First, let us imagine that we are living under such conditions that an imperial edict has been issued that single-phase is par excellence and that henceforth every railroad in the country that wishes to be electrified must use this system. This is not very far from what has happened in Germany. The first fruits of such a condition might possibly be that a great amount of talent would be focussed upon one subject and that developments along certain limited lines might be stimulated. Also, the customers or railroads would be relieved of any worry concerning the selection of the correct system. There would be no choice in the matter; they must take what was presented or leave it. Under such conditions, the field of research and development would be limited to such an extent that any inherent limitations in this one system of electrification would literally form a stone wall across the paths of progress. If there are inherent limitations in any system and we insist on its adoption, we are hindering rather than helping the permanent sound progress of the art. On the other hand, when there are two or more systems that are recognized as competitors, and there are, as it were, opposing camps, one side championing one system and the other side championing the second system, we are building on broader foundations. As a matter of fact, the battle of the systems is merely a bogy—the selection of the best electrical apparatus to meet the service conditions in any particular case is the settlement of engineering details—not the adoption or rejection of a system.

There are some engineering firms that have thoroughly tried out all the apparatus which has been developed up to the present time, and their judgment in these matters is tempered by experience and costly tests, and the railroad companies are getting the benefit of this experience.

The development of the higher potential direct current railroad is of peculiar interest, as the apparatus used has gone through such a logical sequence of evolution. It is just about a decade ago that we began to recognize that 500 or 550 volts was no longer the standard potential for railway work. The voltage had gradually been raised from these figures to 600 volts until there were more roads operating on 600 volts than at any other potential. When this condition was recognized, 600 volts was talked of as the standard. The evolution from 500 to 600 volts was largely brought about by a gradual increase of the traffic on existing systems, the raising of the voltage being the simplest and cheapest method of meeting the severe demands. There have been isolated cases of roads operated at 700, 750 and 800 volts, and the step from these potentials to 1200 volts was a comparatively small one. It should be specially noted that the increase from 500 to 600 volts made no difference whatsoever in the design, construction and operation of the equipments. When the jump to 1200 volts was taken, it was made for purely economic reasons, and no radical changes were made in the equipment. To retain the good and well tried features of 600 volt control, a very simple piece of apparatus called the "dynamotor" was devised which enabled the control and auxiliary circuits to be operated at 600 volts and the main motors to use the higher potential. The only change in the motors to suit the higher voltage was that they were

insulated for 1200 volts instead of 600 volts, the common arrangement being to operate two motors in series so that 600 volt windings were still used. The adoption of commutating poles on railway motors greatly facilitate the raising of the trolley potential without the introduction of complications. The marked success that attended the operation of 1200 volt apparatus under severe service conditions encouraged further steps along the same line with the result that some roads of 1500 volts were installed. The results were equally satisfactory. Most of the roads at present operating at higher direct current potentials are in the nature of interurban railways but some, however, approximated steam railroad conditions. In all cases the apparatus has proved itself as well suited to the severe conditions as the older 500 and 600 volt apparatus had. Under these circumstances it is not surprising that a still higher direct current potential should have been considered for a heavier class of service. In 1912, just five years after the first 1200 volt road was put into successful operation in this country, 2400 volt direct current was adopted as the most suitable system to meet the peculiarly severe conditions existing on the Butte, Anaconda & Pacific Railway—thus direct current apparatus has evolved from a small beginning until it has reached a stage where it meets the demands of the heaviest traction undertakings contemplated.

This is as far as we have gone at present in this direction, in actual practice, but there seem no logical reasons or limiting conditions, that we know of at present which would prohibit the use of still higher direct current potentials.

Since the initial adoption of 1200 volts, the extension of its use has been exceedingly rapid, and it may now be regarded as the standard for all new interurban railways. In some cases where marked economies can be secured 2400 volts may be used in interurban service. One example of this is already under construction, viz., the Michigan & Chicago Railway.

High voltage D.C. systems

The first road to adopt 1200 volts in this country was the Pittsburgh, Harmony, Butler & New Castle Railway. This road started operation in 1907. Since this date, the extension of high potential direct current railways has been exceedingly rapid as shown in the following table.

Date of Installation	No. of Roads	Total Road Mileage
1907	1	41
1908	2	134
1909	0	0
1910	6	424.6
1911	2	201
1912	3	196.5
1913-14	17	1061
Totals	31	2058.1

Most of the roads are in the nature of interurban railways, but it should be noted that as far as we can see the vast majority of the heavy traction work now under construction or contemplation will employ direct current apparatus and this will, in most instances, be operated on "higher potentials."

We are apparently fast coming to recognize that there is such a thing as "a science of development" and that such a science among other factors must include the following fundamentals:

(1) An accurate determination of the actual operating conditions which will enable us to settle definitely what is wanted.

(2) The co-ordination of the work of a large number of differently trained men, so that the finished product may embrace the experience of each worker in his particular line, and thus become in every detail the product of experts.

(3) The confidence and co-operation of the users and makers of apparatus both before and after its manufacture, this co-operation to continue in some form or other during the useful life of the machine.

(4) The standardization of apparatus when such will be profitable to all concerned.

Summary

(1) There are, perhaps, many who do not realize the costliness of determining what is wanted to suit a particular set of service conditions. An accurate determination of the precise requirements will often necessitate months of exhaustive investigation ,often including costly tests. This is particularly true in large undertakings. If we compare the work done in this direction to-day with the older haphazard methods of designing machinery first and seeing whether it would do the work afterwards, it is apparent that the art has benefited enormously by the work of the large corporations along these lines. Some phases of the research and development work undertaken to-day are so costly and require such a large staff of expert workers that no small engineering undertaking could shoulder the burden, as assumed by the large corporation.

(2) The proper co-ordination of the work of a host of men who are contributing to the design, manufacture and testing of electric railway apparatus is no small part of the Science of Development. The extent of this work is enormous, including as it does, preliminary proposition, final proposition, designing, drafting, actual manufacture and work incidental to following apparatus through the factory, assembling, testing, installing, and preliminary operation. The final cost of the apparatus depends largely upon whether this co-ordination of work is done in a scientific or unscientific manner.

(3) A whole paper might be read with profit on the subject of the confidence and co-operation between the user and the maker. Upon the encouragement and extension of what we might call "the modern business idea," the rapidity with which we are going to develop in the future must largely depend. The successful development of electric apparatus for traction purposes depends on "how it is made" and "how it is used." The manufacturer is dependent upon the user just as the user is dependent upon the manufacturer. An ounce of mutual confidence and co-operation will do more towards the development of the art than a ton of fault finding and mutual distrust. In the broadest sense, the aims and objects of both parties are identical. The user wants the best obtainable for his service and the maker wishes to produce the best and most efficient apparatus, as upon this his reputation and future business depends. The work of all parties concerned is in reality the part of one great plan.

(4) The correct time at which the standardization of electric apparatus should be attempted is a science in itself, e.g., it would undoubtedly be profitable to all concerned if all trolley systems would co-operate with the manufacturers in using standard apparatus, especially standard railway motors and standard control equipment, where such standards will fulfill the requirements. There will, however, always be special conditions arising that will demand special apparatus, and the things that dictate these special requirements are many and varied, e.g.: Who could have foreseen that the fashion of ladies' skirts could affect the design of railway motors? But such has been the case—the hobble skirt gave birth to the low step car—and the low step car required a new design of motor.

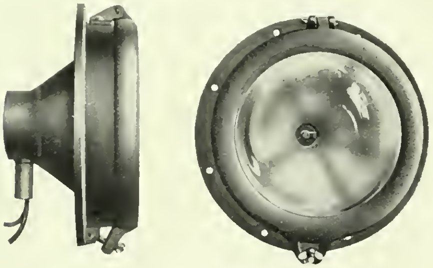
The standardization of all apparatus that is used in large quantities and has reached a high state of perfection would be a great asset to the industry.

On the other hand, until we have more experience with the different systems of electrification, it would seem unwise to lay down too definite standards for heavy traction work, although it might be profitable to standardize such things as trolley voltages that would vitally affect the future development of the art as much as the present.

In conclusion, it is well to emphasize one point, namely, that modern engineering involves, above all things, the study of economics. Yesterday we were finding out how to do things—to-day we are striving to find out how to do them more cheaply than yesterday. To combat the increased cost of living and of labor, etc., and the generally more complicated social and commercial conditions under which we are living, the work of the scientist and the engineer is to teach the world at large how to do for one dollar that which they could not do for two dollars yesterday.

New "Golden Glow" Headlights

The Esterline Company, Indianapolis, Indiana, have just added two new "Golden Glow" headlights to their line. These two types are designated as SR-95 and SE-95. While these two new headlights embody the use of the Golden Glow glass reflectors which characterize this company's products, they possess several new and important features. The lamp bodies and fronts are made entirely of pressed steel, which materially reduces the weight and improves the appearance of the headlights. In the design of these lamps the makers have taken advantage of the accuracy with which steel stampings can be made, producing a headlight which is water and dust proof. A metal ring which holds the reflector in place, also



New type "Golden Glow" headlight

clamps a heavy gasket over which the front or door presses, making a very tight joint. The hinges and latches are designed so as to have no projecting portions, which are likely to catch wires or ropes. Another innovation is the use of electric welded joints and fastenings instead of screws or rivets. The headlights are properly ventilated in such a manner as not to admit dust or water, which prevents sweating and clouding of the reflector and front glass. Recent tests of these new headlights fitted with a 36 watt bulb on a city street, on a dark clear night, showed that the second hand of a watch can be read at a distance of 600 feet and that from the car, a man lying on the track can be seen further than is possible with an arc lamp.

Are Using Nitrogen Lamps

The Ontario Hydro-electric Power Commission are already making extensive use of the new type nitrogen-filled tungsten lamps. Two initial installations of approximately 500 lamps each are planned for street illumination at Hamilton and Windsor. In the former city 500 watt multiple burning lamps are to be used, and ornamental fixtures especially designed to provide the proper ventilation so necessary in connection with nitrogen lamp operation are being constructed. At Windsor the series burning nitrogen lamp will be installed and each unit will be of the 500 watt, 6.6 ampere type. These two novel installations will be followed with considerable interest, and it is safe to say that when completed the two cities will have, in point of illumination, street lighting systems equal to anything on the continent.

Personal

Mr. J. Morris has been appointed engineer-in-charge of the electric light and pumping plant of Newmarket, Ont. Mr. Morris was formerly at Mount Forest.

Mr. A. W. Ormsby, superintendent of the electric light and power department of the city of Edmonton has been east on a business trip covering Winnipeg, Chicago and other large cities.

Mr. J. H. Ward formerly of Tottenham, has been appointed electrician in charge of the electric plant at Acton, where power is obtained from the Guelph sub-station of the Niagara system.

Mr. F. M. Tupper who has been connected with the Allis-Chalmers-Bullock Company, for the last eight and one-half years in Winnipeg and Calgary, has joined the sales force of the Moloney Electric Company of Canada. Mr. Tupper will be district manager of the Winnipeg office.

Mr. Thos. Henry has been appointed electrical inspector for the city of Toronto. Mr. Henry has for years held the position of Chief Engineer of the Interurban Electric Co.

Mr. William O'Hara, chief engineer of the Newmarket electric light and power department has resigned.

New Books

Molded Electrical Insulation and Plastics—by Emil Hemming; Ward Clausen Company, publishers, 200 Fifth Ave., New York. The purpose of this book is to deal with the progress of moulded insulation, to trace its development during the last ten years and to discuss its present status; to treat of the important basic principles of the new products and inventions omitting specific trade names; to give the engineer an insight into materials and methods employed in manufacture, disclosing various characteristics, favorable and unfavorable; and so to guide him to a proper selection of the substance best suited to his wants and requirements. The book includes a number of helpful illustrations.

Electric Light Accounts and Their Significance—By H. M. Edwards, auditor New York Edison Company; McGraw-Hill Book Company, Inc., publishers; price $2.00. The author has been connected for many years with the New York Edison Company and with the accounting end of the National Electric Light Association. As a result the system of accounting advocated in his book is in most respects similar to the systems adopted by these two organizations. The preface points out that a modern public service corporation urgently needs a system of accounting which will enable it to keep track of its affairs and from which all necessary information may be obtained either by those charged with the conduct, of the corporation or by the authority under whose jurisdiction it happens to be operated. It is believed that this book contains a description of such a system of accounts as designed specially for an electric light company. Attractively bound in soft leather covers; size 5-in. x 7½-in.; 172 pages.

The Montreal Tramways Company are appealing to the Privy Council against a decision of the Appeals Court holding that the Quebec Public Utilities Commission have power to order the company to furnish details of equipment, running schedules, service, and their relations with the city.

The Dealer and Contractor

Daylighting Scribner's Book Store

The remarkable daylight effect produced in Scribner's new store on 5th Ave., New York, is a revelation of what can be done through the proper application of laws governing scientific illumination. The arched ceiling effect, which forms the principal architectural feature of this store, is a soft cream white color, and is embellished with a series of simple but rich panel designs. The surface of these arches forms one of the most perfect light-reflecting mediums possible to obtain in architectural construction. At the base of each arch is installed a powerful reflector that throws a strong white light upward. This light spreads over walls and ceiling and is reflected downward, diffusing a mellow glow of pure white light over the innumerable tables, shelves and cabinets filled with many colored volumes.

The light produced by this system is practically a reproduction of daylight, with the result that the finest details are plainly visible, while the most delicate colors can be seen in their true values. This is particularly noticeable when inspecting some of the rare old volumes found in the store.

Good example of book-store lighting.

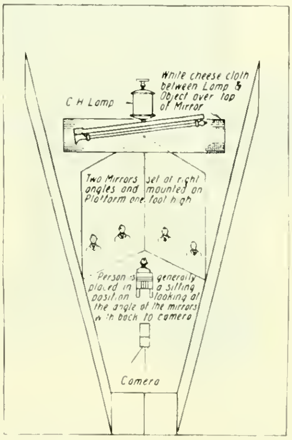
for Scribners have quite a collection of first editions and originals, a few of which are,—one of the earliest Shakespearian folios, a first edition of "Gulliver's Travels," Napoleonic manuscripts in French and English, and letters of Mary, Queen of Scots. Another interesting rarity on view is a first edition of Goldsmith's "Vicar of Wakefield."

The illuminating scheme of this beautiful store is finished with a series of elaborate lamps that hang from the ceiling on chain drops at a distance of about fifteen or twenty feet apart. The powerful lamps used at the base of the arches for indirect or cove lighting are the J-M Linolite lamps. They are about a foot long and an inch in diameter, and have a straight tungsten filament that runs from end to end. This filament produces a continuous "line of light" that diffuses the illumination evenly over the entire surface to be lighted—in marked contrast to the spotty effect produced by the bulb type of lamp.

Multiple Photographs

The scheme of showing in a photograph four or five likenesses of one individual has always proved an attractive one because of a certain air of mystery surrounding it. To the average person it is quite mystifying how the different poses can be secured of the same individual all on one plate. The attached sketch shows how this may be effected.

There are two special mirrors with frames only on three sides each five feet high and three feet wide placed at a 72 deg. angle to each other, the angle being formed by the edges of the glass alone. The subject sits at a table with his back to the camera, facing the angle formed by the mirrors. The camera then points at the back of his head, and the reproduction obtained from the combination of the mirrors



How multiple photographs are made.

results in showing on the plate a reproduction which looks as if five men were sitting at the table, each an exact duplicate of the other. Frequently, the subject is photographed playing cards, and this results in a view of five men, exactly the same in appearance, playing a game of cards with each other.

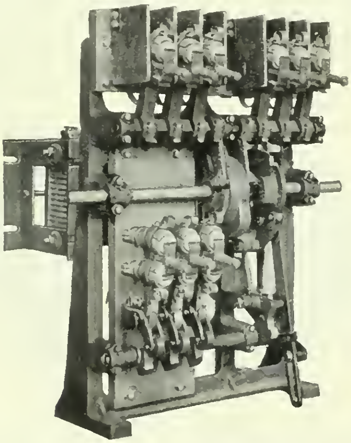
Not the least important feature of this scheme is that of securing the right light with the proper diffusion. In this case, the well-known Cooper Hewitt lamp is suspended directly over the man's head, and about half way between the location of the man and the mirrors. White cheese cloth is placed between the lamp and the object over the top of the mirrors in order to further increase the diffusion. The accompanying illustration shows how the scheme may be worked out.

The Hydro-electric Power Commission have awarded contracts for the construction of distribution stations at Creemore, Port McNicol, Waubaushene, Strathroy, Tilbury.

New Elevator Controller for A.C. Equipment

Because of the extensive use of central station service many buildings, factories and industrial plants use alternating current for lighting and power, including the elevator drives. In many plants where an electrician or high grade engineer is not available for making adjustments, there has been a tendency to favor the use of a.c. elevator controllers which do not employ any solenoid-operated switches. To meet this demand with a high grade controller embodying straight mechanical operation The Cutler-Hammer Manufacturing Company of Milwaukee have added to their line of a.c. automatic and semi-automatic elevator controllers a full mechanical type which meets the needs of many equipments. This controller is made for use with polyphase slip-ring induction motors and has no electro-magnets or sliding contacts. It is arranged for operation from the car by either rope or lever, the shaft having an extension at each end so that the controller can be adapted for either right hand or left hand operation. This controller has the further advantage of operating satisfactorily on circuits having a very wide voltage variation.

The primary circuit is controlled by two sets of switches, each set consisting of three single-pole switches, equipped

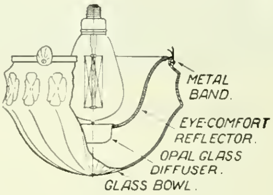


Controller for a. c. elevator operation.

with arcing shields. Each set of primary switches is operated by a special internal cam, arranged so as to give an absolute "knock out" to the switches when opening, and also an absolute "lock out" for the second set of switches, when the first set is thrown in. The secondary resistance is cut out by three triple-pole cam-operated switches. Immediately after the primary switches are thrown in a catch is released, allowing a weight to drop, the motion of which is retarded by a suction dash-pot. This weight in turn drives a shaft on which the necessary cams are mounted for throwing in the secondary switches. The secondary resistance is cut out simultaneously in all three phases of the rotor circuit, thus insuring a balanced condition at all times. The secondary resistance is re-inserted upon the opening of the primary switches and a latching arrangement is also provided so as to prevent accidental operation of the controller, if the operating mechanism is not thrown to the central position. The type of electrical "butt" type contact is the same throughout thus simplifying renewal of parts subject to wear. All of the contacts have a wide range of adjustment, thereby giving maximum life. A notched star wheel gives an accurate indication of the "off" and "running" positions.

Eye Comfort Luminous Bowl

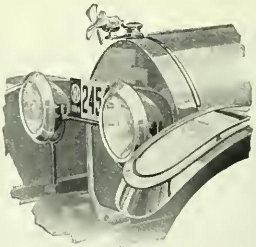
The accompanying illustration shows the "Eye Comfort" luminous bowl principle. By means of a powerful one-piece silvered glass reflector the light from the lamp is directed to the ceiling at the proper angle. From the ceiling the light is diffused evenly throughout the entire room, eliminating all glare and sharp shadows. The small portion of light which comes through the opening in the bottom of



the reflector is redirected by an especially designed opal glass diffuser so as to evenly and softly illuminate the glass bowl for decorative effects. No useful light reaches the working plane directly through the glass bowl.

Automobile Novelty Fan

As a feature of their advertising helps for electrical dealers and contractors, The Robbins & Myers Company, Springfield, O., have made up a small novelty fan which can be mounted on the radiator of a motor car, as shown by the illustration. The fan spins by the air current created by the motion of the car, even when the car is running slowly. Being symbolical of the electrical trade, it makes a dignified advertisement which appeals to every electrical dealer



or contractor who has a motor car. The base of the fan is tapped for a stud bolt, and the usual method of mounting it on the car is to tap the cap which covers the opening to the radiator and mount the fan directly on this cap. Another method which can be followed is to mount the fan on an iron strap which is clamped around the cap, as shown in the illustration above. The fan can be furnished with either nickel or brushed brass finish.

Northern White Cedar Association

An exhibit of Northern White cedar poles, posts and ties is being shown by the Northern White Cedar Association at the Grand Central Palace, New York, from May 21 to 30 inclusive. The object of the exhibit is to demonstrate the durability of this wood. Included are telephone poles of Northern White cedar which have been in actual service for fifty years and which were removed from the line only for this exhibit. Ties are also shown which have been in use for 29 years. It is claimed that this timber is unexcelled in strength, lightness, durability and good appearance. The object of the Association is to establish grades of poles, posts, ties and shingles which will be standard and to maintain these grades, so that purchasers may be assured of procuring material for their particular purposes. A similar exhibit was held in Chicago during the first week in May.

A New Type of Sign

The accompanying illustrations represent night and day views of a very attractive—and attracting—sign installed on King Street East, Toronto. The sign was manufactured by

Day view of sign equipped with bull's eyes.

the Ontario Sign Company, Toronto, and is equipped with their new invention, a spherical type bull's eye. This bull's eye is now superceding the disc form originally adopted on account of the greater efficiency of signs equipped with

Night view of new sign.

them. Experiments show that it only requires approximately one-half the illuminating capacity to operate these signs as compared with the older type of signs using discs.

Mr. C. C. Mendham who has been connected with the outdoor staff in Toronto of the Herbert Morris Crane & Hoist Company, Limited, has now been appointed resident engineer in Berlin for the same company. This appointment is in line with the policy of this company which consists not only in carrying large stocks of their manufacture to ensure prompt delivery, but in furnishing also a consulting engineering service which will advise on the best equipment for any given set of conditions.

By amendments to the Power Commission Act, Ontario townships are now able to make contracts for the supply of hydro-electric energy without submitting a by-law to the ratepayers. All that is necessary is a petition signed by a majority of the freeholders.

New Companies

The Munder Tungsten Lamp Company has obtained an Ontario charter, capital $50,000, head office Guelph.

The Gowganda Power Company, Limited, has been incorporated with head office Gowganda, and capital $1,000,000

The Northern Interior Light & Power Company, Limited, has been incorporated with head office Fort George, B.C., and capital $50,000.

The Weno Power and Light Company, Limited, has been incorporated with head office Calgary, and capital $100,-000.

The St. Thomas Electric Company, Limited, has been incorporated with head office St. Thomas, Ont., and capital $40,000.

The Automatic Electrical Heat Controller Company, Limited, has been incorporated with head office Vancouver and capital $200,000.

The Automatic Telephone Manufacturing Company of Canada, Limited, has been incorporated, capital $1,000,000, head office Winnipeg.

Trade Inquiries

368. **Electrical machinery.**—South American firm inquires for electrical machinery.

Trade Publications

Oil Fuse Cutouts—Circular 150 issued by the D. & W. Fuse Company, Providence, R.I., describing oil fuse cut-outs for high tension work.

Auto-Manuel—Booklet issued by the North Electric Company, Cleveland, Ohio, entitled "Auto-manuel described for the practical telephone man."

Railway Signals—Catalogue Section B, Part 7, issued by the General Railway Signal Company of Rochester dealing with R. S. A. mechanical dwarf signals.

Transformers—Cotalogue just issued by the Moloney Electric Company, Windsor, describing and illustrating in detail the various steps in the construction of Moloney transformers.

Canadian Westinghouse—have issued circular No. 1137 describing and illustrating the construction of their watt-hour meters for alternating and direct current; also folder 4284, describing Westinghouse Railway Lightning Protection; also folder 4197 entitled Electrical Household Helps.

Isolated Power Plants—The Canadian General Electric Company have issued catalogues covering electric plants for lighting and power at isolated points. One of the features of this plant is the use, as auxiliaries, of chloride accumulator batteries. The catalogs cover installations both at the ordinary voltage of 110 and at lower voltages down to 32 volts.

Illuminating Industrial Plants—The Canadian General Electric Company have issued two attractive and informing bulletins dealing respectively with the lighting of woodworking plants and the lighting of machine shops and metal working plants. These are both well illustrated and contain much valuable information.

Overhead Runways—The Herbert Morris Crane & Hoist Company have issued a descriptive pamphlet dealing with the Morirs overhead runway. Interesting illustrations represent very graphically how a lot of money can be thrown away in shifting loads which can be handled more economically and much more expeditiously with the proper runway equipment.

Condulets—A complete catalogue issued by the Crouse-Hinds Company of Canada describing their almost infinite number of types of condulets. The catalogue is splendidly illustrated, much of it in two and three colors. This is in reality a complete treatise on the subject of condulets covering some 210 pages, 9-in x 12-in. size; bound in stiff covers.

Current News and Notes

Amherst, N.S.

The annual report of the Maritime Coal, Railway & Power Company, Limited, shows gross profits for the year of $116,959, an increase of 16.5 per cent. over the previous year. The report states that the main power station at Chignecto has been enlarged during the year by the addition of a 1,000 kw. steam turbo-generator. Also a new concrete dam for power purposes has been built, a supplementary transmission line to Amherst constructed and a new sub-station built and equipped with 1,000 kw. transformer capacity.

Bathurst, N.B.

The Bathurst Lumber Company are equipping their new planing mill with motor drives. About 300 kw. is being installed.

The Bathurst Pulp Company are getting out plans for a large pulp and paper mill. This plant will be electrically-operated throughout. Three 750 kw., 550 volt a.c. turbo-generators will be installed in the power house. It is expected that the plant will be in operation about November 1st. Mr. McDairmid of the Montreal Light, Heat & Power Company, is consulting engineer for both the pulp and lumber company.

Calgary, Alta.

A by-law was defeated on May 11th which asked authorization to spend $300,000 on electric light extensions.

Charlottetown, P.E.I.

The Charlottetown Light and Power Company are changing over their entire system from 133 to 60 cycles and, starting June 1st, will operate a 24-hour system. They have for the past few years been operating both steam and gas engines in their power house, but after the change is completed the entire equipment will be operated by gas engines. Mr. Thos. Coleman is the superintendent in charge of the plant.

Cheltenham, Ont.

The International Brick Company has made a contract with the local Hydro-electric Power Commission for the supply of 200 h.p. This point is served from Georgetown.

Duncan, B.C.

A 200 h.p. Diesel plant is being installed in Duncan, B.C. It is expected to be in operation by September 1 of the present year. It has been announced that the rates will be reduced to 15c for the first 50 kw.h., 12½c for the second 50 kw.h., and 10c for all in excess of this amount with 20 per cent. discount and a monthly meter rental of 20c.

Edmonton, Alta.

Contracts have been awarded by the city commissioners to Babcock and Wilcox for the construction and complete equipment of a new boiler house at the power plant at a cost of $183,800. This is one of the improvements planned by the commissioner of operation, the cost of which is taken out of the obsolesence fund set aside during the past eighteen months.

Edson, Alta.

The town of Edson carried a by-law last year authorizing the expenditure of $45,000 on an electric light and power plant. Owing to the condition of the financial market they were not able to dispose of their debentures to advantage at that time, but we understand that these have now been sold and that work will proceed on the erection of this plant.

Embro, Ont.

A by-law was recently carried authorizing the expenditure of $6,000 for a power distribution system to connect up with a Niagara supply.

Fort William, Ont.

The extensions to Fort William's municipally-owned street railway were commenced a few days ago, and during this summer there will be quite a large programme of construction work carried on. The first work to be undertaken will be the construction of the new belt line along North Syndicate and Pacific avenues, and Victoria Avenue west to Franklin, and Franklin Street south to Walsh Street. The street railway extension to the Island across the Bascule lift bridge is practically completed, and all there remains to be done is a few connections that will be fully completed before the end of May.

Grenfell, Sask.

Permission has been granted by the local government to the town of Grenfell, Sask., to issue debentures to the amount of $6,500 to be spent on extensions to their electric light plant.

Guelph, Ont.

The Hydro-electric Power Commission have decided on a reduction of approximately 10 per cent. on the local rates.

Hagersville, Ont.

Extensions to the electric system are contemplated by the village council.

Hantsport, N.S.

The new municipal lighting plant in this town will be in operation by June 1st and is expected to furnish light and power at a very cheap rate. The apparatus is being installed at D. W. Murray's woodworking factory. Refuse from the mill will be used as fuel. The electrical apparatus is being furnished by the Canadian General Electric Company. Leonard & Son are furnishing the steam equipment.

Kamloops, B.C.

Tenders are called for the construction of a reinforced concrete power house to be built for the Barriere River hydro-electric development for the city of Kamloops. Messrs. Ducane, Dutcher & Company, Vancouver, are consulting engineers.

Leduc, Alta.

The town of Leduc has awarded a contract to the Canadian Westinghouse Company for a 50 kw. generator and switchboard equipment and to the Canadian General Electric Company for all material required in approximately four miles of pole line. It is expected this plant will be ready for operation in August of this year. The contract for the steam equipment has not yet been reported, but it is expected that vertical high speed engines and horizontal return tubular boilers will be used.

Lachine, Que.

The council of Lachine, P.Q., have passed a by-law to expend $600,000 on civic works, including underground conduits for electric wires.

Little Current, Ont.

The property owners of Little Current on May 4th voted

in favor of establishing a municipal electric plant to cost in the neighborhood of $12,000.

Moncton, N.B.

The Moncton Tramways, Electricity & Gas Company will make a number of changes in their plant this year. A 200 kw. synchronous motor-generator set will be installed in the power house to take care of their tramway load. Several will be added . Power lines will be built to the new city additional miles of track will be built and three new cars pumping plant where two 75 h.p. electrically driven pumps are being installed. Judging from the amount of building under way at present this should be a good year for the electrical business in Moncton.

Montreal, Que.

Plans have been prepared by the Electrical Service Commission, Montreal, for three additional streets—Craig, St. James, and a portion of Notre Dame, and tenders for the work will be called in June.

The Standard Underground Cable Company of Canada, Limited, Hamilton, Ont., have received orders from the Montreal Public Service Corporation and the Montreal Tramways Company for over 200,000 feet of cable. This will be used in connection with the underground conduits on St. Catherine and Bleury streets, constructed by Mr. G. M. Gest for the civic Electrical Service Commission. The city now requires that all wires be placed underground.

An order for a switchboard has been given to the Canadian Westinghouse Company by the Canadian Light and Power Company. This is part of the new generator equipment which is being installed at the company's plant at St Timothee, P.Q. The new unit will have a capacity of 5,000 kv.a. under a 48-ft. head.

The first order for a British cable for the United States has been received by the British Insulated and Helsby Cables, Limited, Prescott, England, with which the Canadian British Insulated Company, Montreal, is affiliated. The order is for 55,000 feet of 3-phase, 25,000 volt, .1 square inch split conductor cable, and was received from the Edison Electric Illuminating Company of Boston. Approximately half the cable is single wire, armoured, finished with Merz tapes and the balance plain lead covered. The cable is to be laid under the supervision of the British company.

The Montreal Harbour Commissioners have made a contract with Darling Bros., Limited, Montreal, for two electric hoists, similar to the one recently installed. They will each have a lifting capacity of 30,000 pounds.

The Montreal and Southern Counties Railway have opened their extension to St. Cesaire, a distance of 31 miles from Montreal. The further extension to Granby will be built this year.

Nelson, B.C.

Negotiations are being carried on between the Johnson Electric Smelting Company and the city regarding the establishment of a plant in Nelson. The Johnson process is a recent invention for the electric reduction of zinc ores.

Newcastle, N.B.

The power plant in connection with the Universal Radio Syndicate, Limited, wireless station was put in successful operation during the month of April. This is an installation of two 250 h.p. three cylinder vertical oil engines direct connected to 150 kw. 1100 volt, direct current generators. The current from these machines is carried in ducts to the operating house which is located about 2,000 ft. away from the generators. A 15 kw. motor-generator set is installed for lighting and charging storage batteries. All towers, guy and aerial wires are insulated for 60,000 volts. The oil engines were built by the Franco Fosi Company of Lagano, Italy, and the generators and switchboard by the Insulated Rubber and Gutta Percha Works of London, Eng. The company expect to have the plant in commercial operation about June 1st.

Ottawa, Ont.

The Carling Exchange, Ottawa, of the Bell Telephone Company, will be cut in about June 15th. The exchange is constructed to take care of additional business.

The Canadian Street Railway Association is holding its annual convention in Ottawa, May 13 and 14.

The W. C. Edwards' bill asking permission to sell surplus electric energy in and around Ottawa has been modified to the extent that the rates have been placed under the control of the Hydro-electric Power Commission of Ontario.

Point Edward, Ont.

Mr. H. A. McLean, engineer to the town of Sarnia, has recently placed an order with the Herbert Norris Crane & Hoist Company for one of their standard type G hand operated overhead traveling cranes. This crane will have a capacity of 10 tons and a span of 49 ft. 3 in. The crane is to be used in the new pump house at Point Edward.

Port Coquitlam, B.C.

It is reported that the McNairn Lumber Company will install an electric lighting system throughout their camps along the Coquitlam River. It is stated that they will also install a telephone system connecting the various camps and the mill. Power for electric light has been secured from the B. C. E. R. Co.

Port Elgin, Ont.

The annual meeting of the Bruce municipal telephone system shows assets of $95,464. There are approximately 1,000 telephones now in use and the rate charged is $12.50 per annum.

Port Hawkesbury, N.S.

There is a movement on foot to install an electric lighting plant in this town. At present the North Atlantic Fisheries Company have a 50 kw. outfit installed at their cold storage plant and it is proposed that they operate a lighting system for the town.

Prince Albert, Sask.

A proposition has been received from an Ottawa syndicate regarding the construction of a street railway system in Prince Albert. The syndicate ask for a twenty-year franchise.

Plans and specifications for a new telephone building have been prepared by Storey & Van Egmond, architects, Regina, and the contract for the erection of the building has been let to the McKay Construction Company, Regina. The building is being constructed by the Saskatchewan government and is very similar to the building recently erected in Regina. It will be of steel construction with reinforced floors, walls of brick with stone trim, two storeys and basement. The automatic system of telephones will be installed

Regina, Sask.

The operation returns for the municipal street railway system, Regina, for the week ending April 18th, are as follows:—revenue $3,757.15; passengers carried 87,752; passengers carried including transfers, 98,632. For the week ending April 25 corresponding figures are $4,145.50, 97,358 and 109,866. For the week ending May 2, the returns are $3,696.10; 88,811; 99,686.

The following companies have been authorized to borrow money for telephone systems:—Guernsey Rural Telephone Company, Limited, $10,500; Goodwater Rural Telephone Company, Limited, $6,000; Ideal Rural Telephone Company, Limited, $7,800; Adanac Rural Telephone Company, Limited, $5,500; Forward Rural Telephone Company, Limit-

ed. $7,500; West Froude Rural Telephone Company, Limited, $3,700; Dumas Kennedy Rural Telephone Company, Limited, $2,000; Willsmer Rural Telephone Company, Limited, $6,800; Ardine Rural Telephone Company, Limited, $2,500.

Sackville, N.B.

The Eastern Electric & Development Company who operate the light and power service in this town recently applied to the Public Utilities Commission of New Brunswick for permission to increase their rates. A number of sessions of the Commission wehe held and their decision was against the increase in rates. A new hearing will likely be asked for.

Saskatoon, Sask.

A by-law was recently defeated which asked authorization to expend $200,000 on electric power house and electric distribution extensions.

Stellarton, N.S.

The corporation of Stellarton is making extensive additions to their plant and after June 1st will operate a 24-hour power service. Orders have been placed covering one 187½ kv.a., 3-phase, 2,200 volt, 60-cycle generator with generator and feeder panels; also one 250 h.p. turbine water wheel and material for five miles of power line. The operation of the plant during the past three years has been remarkably successful while the rate for lights is possibly the lowest in eastern Canada. Gideon Dexter is the superintendent in charge of the plant.

St. John, N.B.

The application of the St. John Hydro-electric Company for an extension of time to begin work on the erection of a dam across the St. John River above Fredericton to develop power on a large scale has been rejected by the local legislature. The St. John Railway Company were also refused authority to make a new issue of bonds as the amount already authorized has not all been taken up.

The St. John Street Railway Company have awarded a contract for the building of a new car barn to A. R. C. Clarke & Son. The building is to be 115 ft. x 58 ft., of steel and brick construction.

Stouffville, Ont.

The town council have issued orders to the superintendent to reconstruct part of the distribution system.

St. Stephen, N.B.

The St. Croix Gas Company have recently put in operation a 24-hour service and are building up a very substantial power load. This company operates a water power plant and furnishes light and power to the four towns of Calais and Milltown, Maine, U.S.A., and St. Stephen and Milltown, N.B. It is understood that the Calais Street Railway Company who operate a tramway line in these towns will also enter the power field and install additional apparatus and extend their a.c. power lines. This latter company are at present supplying power from their trolley line at 500 volts to several of the factories in St. Stephen.

Stratford, Ont.

A by-law will be submitted on May 18 authorizing the expenditure of a further $22,000 on the street lighting system.

A by-law will be submitted on May 18 asking authority to purchase additional fire equipment at a cost of $17,250.

Swift Current, Sask.

A contract has been awarded to the Gilstrom Contracting Company for the erection of an electric power house.

Toronto, Ont.

A bill has been introduced in the local legislature amending the Telephone Act. Power is now given the Ontario Railway & Municipal Board to prevent unnecessary duplication of telephone systems, to regulate the hours of employment of telephone operators and to approve agreements of interchange of traffic, sale of telephone companies, etc.

Vancouver, B.C.

The new Vancouver hotel named Hotel Vancouver will be equipped with more than 750 telephones.

It is stated that the J. Z. Lajoie Company, the incorporation of which was recently reported in the Electrical News, is a subsidiary of the Canadian Northern Railway Company and the purpose of the new organization is to develop the Lajoie Falls to supply power for the operation of the C. N. R. tunnel now under construction.

Vernon, B.C.

The installation of a 525 h.p. Diesel engine generator set is at present under way in the Vernon power house.

Wallaceburg, Ont.

The local company have offered to sell out the electrical end of their plant to the town for $30,000 and a by-law will be submitted in the near future.

Wapella, Sask.

The Brookside Rural Telephone Company are calling tenders for the construction of their system.

Windsor, Ont.

The Canadian British Insulated Company, Montreal, have closed an order with the Corporation of Windsor for 10 miles of single conductor 4000 volt armored cable.

Winnipeg, Man.

Proposed extensions to the street lighting system being discussed at the present time include an installation of ornamental standards on Portage Ave. from Carlton to Maryland.

Wolseley, Sask.

A by-law will be submitted on May 29th authorizing certain extensions to the electric light system of the town

Electrical News
Generation, Transmission and Application of Electricity

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Exit Toronto's "Expert"

The "scathing denunciation" by Chairman McIntyre of the Ontario Railway & Municipal Board of one of the so-called "experts" in the recent valuation of the Toronto Railway System places one more obstacle in the way of an agreement between the company and the city. Now, more than ever, the electors will find it difficult to form any satisfactory judgment regarding the real value of the property, as the Board's finding implies both dishonesty and incompetence.

It has, of course, all along been an entire mystery to the engineering profession why a person with neither technical knowledge nor practical experience in such matters should have been named by a responsible body like the Toronto Board of Trade to represent the city's interests in so important a valuation. The natural conclusion was that this appointee possessed other qualifications in a superlative degree, and not obtainable in an engineer, which specially fitted him for the task. Chairman McIntyre has, however, failed to unearth any qualifications that will tend to increase the confidence of the citizens of Toronto in the recent railway valuation, in so far, that is, as it was prepared by the local "expert." It should not now hurt the feelings of the Board of Trade, City Council or whatever body was chiefly responsible for this appointment to suggest that they acted entirely without judgment. We will go so far as to suggest that if the value of the local street railway system is required there are many engineers—in Toronto—who can determine it. The Engineers' Club, for example, has a membership of approximately 500, including engineers as capable probably, as any on the continent, and the poorest of which at least would do the city no discredit. We are of the opinion that an inquiry at these technical quarters would have resulted in the selection of a man and the preparation of a report in which the council and electors could have placed confidence. Having the financial interests and the moral reputation of the city at heart we earnestly commend this policy in future where technical information is required. In the present instance we think it only just to Canadian "engineers," to state that the reference in Chairman McIntyre's report does not apply to one of their profession—a profession, we have good reason to believe, in which honor is an outstanding characteristic.

Insulation Resistance and Moisture

A valuable paper was recently presented by Mr. S. Evershed before the Institution of Electrical Engineers on the subject of "The Characteristics of Insulation Resistance." Mr. Evershed's paper is the result of some three years of experimental work, and though, as the author points out, this work is far from complete, enough has been done to form a basis for future work. Three phenomena considered by the author are the effect of moisture, of voltage and of polarity. Inasmuch as the experiments have not yet been completed the paper deals chiefly with the first of these, the effect of moisture. The difference between the applied potential difference and the insulation from resistance has been traced by the author, in a curve, from a few volts up to the break down point. This curve consists in general of two parts of opposite curvature connected by a more or less straight line, the length of which varies with the nature and condition of the insulator. The first part of the curve, the author finds, is determined by the extent to which leakage is due to moisture. The author's experiments show that the leakage through the insulator for this part of the curve is practically negligible and that for all practical purposes the insulator may be regarded as having no inherent conductivity, the conductive power which it appears to possess being caused by leakage due to moisture either on the surface or absorbed in the interior. Throughout the experiments the presence of moisture is shown to be a determining factor which regulates the breaking point. This factor is given as explaining why there is so much discrepancy between break down tests in the factory and in actual operation. The author states that his experiments indicate that the only place where this discrepancy is not shown is with non-absorbent dielectrics. Brief extracts from Mr. Evershed's paper are printed elsewhere in this issue.

The Nova Scotia Tramways and Power Company

The bill incorporating the Nova Scotia Tramways & Power Company, Limited, has been passed by the local legislature with a number of amendments to the original bill designed to safeguard the interests particularly of the citizens of Halifax. As the bill stands the capital of the company is $6,000,000 and in addition to absorbing the Halifax Tramways Company, with its obligations and franchise rights the new company may also acquire the power sites and rights on the Gaspereaux River owned by the Nova Scotia Light & Power Company. The new company undertakes to commence actual work in the development of one of their water power sites within two years from the date of the passing of the Act and to expend not less than half a million dollars in another two years. It is also agreed that the yearly payment to the City of Halifax shall never be less than that paid in 1913 by the Halifax Tramways Company and that the rates for light and power shall never be increased above those paid at the present time; also the fares now charged on the local railway shall not be increased and in addition workmen's tickets at a price of 8 for 25c shall be sold in future. Points at issue shall be referred to the Public Utilities Commission.

An Electric Farm Installation

Mr. C. E. Locke, Edgeway Road, near St. Thomas, is one of a number of farmers who are taking advantage of the ample supply of electric energy in that district, and has had his farm buildings and residence equipped throughout with light and power. Mr. Locke has contracted for 2 h.p. on a flat rate from the lines of the Hydro-electric System and is receiving his power from the commission at 110 volts, 3-phase, 25-cycles.

The residence is wired throughout with the average run of fixtures in each room. Provision is also made for an electric grate in the parlor and an electric heater in the bathroom. It is also the intention to make use of a number of the modern household appliances such as irons, toasters, vacuum cleaners, etc. The house is of very commodious dimensions being the old typical farm-house, brick construction.

Mr. Locke pays particular attention to his dairy department and will use considerable electric energy both for light and power in this connection. The milking room, cooling room, driving shed, stable and work shop have been lighted throughout with tungsten lamps. The farmyard and driveway, as also of course the house, will be lighted with tungstens.

In the barn he has also supplied a 2 h.p. Crocker-Wheeler motor, 110 volts, 25-cycle, 3-phase which he uses for running the chopper, grinder, milking machine, turnip pulper, etc.

There is also installed an electric water heater of Hot Point variety for heating water in the milking room for cleaning the milking cans. The advantage of this heater is that it can be left in operation during the night when all other power is off and in this way it does not increase the peak load on the lines.

Pleasure Resort at Deep Bay

In connection with the operation of its Saanich interurban line, opened for service last year, the British Columbia Electric Railway is planning for the development of a pleasure resort on Vancouver Island to meet the demands of residents and visitors to Victoria, the capital of British Columbia. The line passes for 22 miles through a country which is magnificent from the landscape point of view and which will probably ultimately become the location of many large suburban country estates.

The initial work of the company in the line noted is being carried out at Deep Cove, the northern terminus of the line. The place is naturally suited admirably for the demands of the pleasure seeker or picnic party, providing the attraction of groves on the one hand and excellent bathing beaches on the other. It is located only a run of a little over an hour from Victoria and with the frequent train service given will probably be a popular resort.

To meet the immediate demands the company is now building at the terminus a tea room and refreshment booth which will also meet the demands of a small number of permanent guests. The building is 50 by 56 feet in size and two storeys in height. It is of frame construction and of ornamental design, the lower storey being weatherboarded and the upper storey shingled. The ground floor is divided into rest rooms for ladies, large tea room, refreshment counters, toilets, etc. The two sides of the building facing the Saanich Gulf are surrounded by wide varandas. The upper floor is divided for apartments for the caretaker and several guest rooms.

The company contemplate the construction of another wing of similar type and the joining of the wings so as to form a summer hotel, 102 by 56 feet in dimensions and providing for the demands of a large number of summer guests. This work will probably be carried out next year.

In the Saanich Gulf and within easy reach of Deep Cove are a large number of small islands, all of which are partially settled. It is probable that a daily launch service will be arranged during the summer, connecting with the interurban trains, thus combining the pleasure of an interurban run and launch ride outing.

European Telephone Systems

In his recent work "The public ownership of Telephones on the Continent of Europe" the author Dr. A. N. Holcombe, does not favor competition and writes as follows regarding public ownership,—"In the telephone business, competition is a failure. Considered as an automatic arrangement for maintaining an accurate adjustment of the supply of telephone facilities to the demand, it easily gets out of order. So long as it remains in order, its effect is to diminish the utility of the service to render which telephone facilities are created. For a while it is capable of bringing about low rates and stimulating a rapid development. Sooner or later, however, the self-interest of the competitors or the disillusionment of the public authorities will cause the termination of competition and the substitution of a regime of monopoly. This has been the result everywhere in Europe where competition has once existed, except in Stockholm, and in Stockholm the bankruptcy of the private company or the purchase of its business by the government is only a matter of time. Competition as a permanent status in the telephone business is neither desirable nor possible." A review of success in Germany and Switzerland, and failure in France, leads Dr. Holcombe to the conclusion: "For under the actual alternative to public ownership in such an industry, namely, a well-regulated private monopoly, there is no greater security for sound industrial progress than under public ownership, and it is certain that at least a portion of the advantages of industrial progress will be appropriated by the monopolist, solely by virtue of the fact that he is a monopolist. The great merit of public ownership, therefore, as an agent of production, is that under the proper industrial conditions it fulfils, more economically than any other method of industrial organization, the direct purpose of production,—that is, the supply of the consumer with the kind and quantity of goods that he desires."

Vaudreuil Electric Company

The Vaudreuil Electric Company, Limited, organized under a Dominion charter to distribute power generated by the Cedars Rapids Manufacturing & Power Company (of which it is a subsidiary) are constructing a 12,000 volt, two circuit pole transmission line from Cedars to Vaudreuil, P.Q., a distance of six miles. The chief object in the organization of the company is to create an industrial development in the vicinity of Vaudreuil, where cheap electrical power in great quantities, low-priced manufacturing lands adjacent to the main lines of the C. P. and G. T. Railways, and Ottawa River water transportation, all near Montreal, would seem to offer inducements for the location of manufacturing industries. This company are also building 2,200 volt mains, street series and 110 volt secondaries in Dorion and Vaudreuil villages, including a 12,000 cable crossing Soluanges Canal with the necessary sub-stations. The company expect to furnish street, residential and commercial lighting and power in Vaudreuil and Dorion villages by July 1 next and will extend their lines to Cedars Village, Hudson, Como, and Hudson Heights. The line will also be further extended to Ottawa and St. Lawrence river points as required. Power is at present being purchased from the Provincial plant of the Montreal Light, Heat & Power Company, and supplied over the four-mile 2,200 volt line to manufacturers at Cascades, Que., until the Cedars plant will be in operation on January 1, 1915.

The officers of the company are: President, Howard Murray (vice-president Cedars Rapids Manufacturing & Power Company, and vice-president Shawinigan Water & Power Company); secretary-treasurer, James Wilson (secretary of the Shawinigan Water & Power Company); manager, S. H. Brownlee, (late of Cedars Rapids Manufacturing & Power Company, and Ontario Power Company, Niagara Falls). The contract for the construction of the transmission line has been let to Mr. S. W. Hamilton, Coristine Building, Montreal.

An Inspection Engineering Company

The recent formation of an "Inspection" company is practically a new development in the Canadian electrical field and is of special interest to engineers and purchasers of electrical apparatus. The new company will be known as the Allen Inspection Company and will have head offices at 306 Kent Building, Toronto. This company will specialize in inspection during manufacture, and make tests and reports on electric power apparatus, insulators, steel towers, transmission line hardware, wires and cables, conduit, etc. Resident inspectors will be located at important manufacturing centres, and the company is prepared to look after contracts for consulting engineers, operating companies, municipalities, governments, manufacturing companies and others requiring specialists for this class of inspection work.

The manager of the company is Mr. A. D. Allen, who has had a broad experience in this class of work. Before entering McGill University, Mr. Allen had several years' practical experience in the shops of large electrical manufacturing companies in the United States and later was engaged on construction work in the Niagara district. Since graduation he has acted as inspector for the Shawinigan Water and Power Company on the equipment required for their new 75,000 kv.a. generating station and 100,000 volt transmission system. In addition he has looked after inspection work for various consulting engineers on a number of important power developments installed in different parts of Canada during the last three years.

New Rates in Moose Jaw

The city of Moose Jaw have rearranged their schedule of light and power rates and the following will be effective July 1, 1914.

Lighting—With one meter—for all current used by one installation and through one meter, 7c per kw.h. meter rental 25c per month; minimum charge 75c per month.

Commercial or Domestic Lighting, Heating, Cooking or Small Motors on lighting circuit—(with two rate meter)—For all current used between 4.30 p.m. and 11.00 p.m. from September 1 to March 31 and between 7 p.m. and 11.00 p.m from April 1 to August 31, 7c per kw.h. For all current used between 11.00 p.m. and 4.30 p.m. from September 1 to March 31 and between 11.00 p.m. and 7.00 p.m. from April 1 to August 31, 3c per kw.h. Minimum charge $3.00 per month; meter rental 25c per month.

Power—A fixed charge of $1.00 per h.p. per month of maximum demand or connected load is charged with an added meter rate depending on the amount of the consumption. The meter rate up to 3 h.p. is 3.5c per kw.h.; from 4 to 10 h.p., 3c per kw.h.; from 11 to 25 h.p., 2.5c; from 26 to 50, 2c; from 51 to 100, 1.5c; all over 100 1.25c. Discounts vary according to the class to which the customer belongs, there being four classes, A, B, C and D, very similar to the schedule of the Hydro-electric Power Commission of Ontario.

International Engineering Congress

Among the general subjects to be treated before the International Engineering Congress which meets in San Francisco, September 20-25, 1915, one of the broadest is that of "Materials in Engineering Construction" a subject of interest in all phases of engineering activity. The list of topics is very complete and includes among others the following:—(a) "The place of Copper in the Engineering Field"; (b) "Alloys and their use in Engineering Construction"; (c) "Aluminium in Engineering Construction." Other topics are:—"Timber"; "Preservative Treatment of Timber"; "Substitutes for Timber in Engineering Construction"; "Brick in Engineering Structures;" "Clay Products in Engineering Structures;" "Probable and Presumptive Life of Concrete Structures made from Modern Cements;" "Aggregates for Concrete;" "Slag Cement;" "Waterproof Concrete;" "Cements containing Additions of Finely Ground Foreign Material;" "Economics of the World's Supply of Iron;" "The Life of Iron and Steel Structures;" "The Employment of Special Steel in Engineering Construction."

Convention of Electric Vehicle Interests

By far the most successful convention of the New England Electric Vehicle interests, conducted jointly by the Electric Motor Car Club of Boston, and the New England section of the Electric Vehicle Association of America, was held Tuesday and Wednesday, May 19 and 20, in the Engineers' Club, Boston, Mass.

The papers presented were: "Co-operation," by W. H. Blood, Jr., former president of the Electric Vehicle Association; "Recognition of the Electric," by Hayden Eames of the Standard Electric Car Company; "The Electric Vehicle Association," by A. Jackson Marshall, executive secretary of the electric Vehicle Association; "What Constitutes a Good Electric," by A. C. Faeh of the Rauch & Lang Carriage Company; "Utility of the Electric Vehicle, Pleasure and Commercial," by A. J. Bartlett, Baker Motor Vehicle Company; "Garaging and Service," by J. C. Bartlett of the Bartlett Garages, Philadelphia; "The Relative Fields of Gasoline, Electric, and Horse Trucks," by H. F. Thomson, Massachusetts Institute of Technology; "Touring by Electric Automobiles," by J. S. Codman, S. R. Bailey & Co., Boston; "Competition, Fair and Unfair," by Vere Shaw of the Peerless Motor Car Company; and "Weak Links in Electric Truck Salesmanship," by F. Nelson Carle of the General Vehicle Company.

An open business forum was conducted by Converse D. Marsh of New York. On Tuesday afternoon, a visit was made to the very large and complete electric garage of the Edison Company at the Service Building, which afforded an opportunity of noting how the Edison fleet of some eighty-five electric vehicles is cared for. A beefsteak dinner was served later in the Edison Service Building, adjacent to the electric garage. On Wednesday afternoon, electric vehicles conveyed all those attending the convention to Bass Point where a very interesting baseball game was played between the Edison Company employees and representatives of Electric Vehicle interests, the game being won by the former.

Canadian Electrical Association Convention, Montreal, June 24, 25, 26

Electric Machinery at the Panama Exposition

The Department of Machinery has been actively engaged upon the allotment of space in the Palace of Machinery. The area of this building is 369,600 sq. ft. The exhibits will comprise, it is claimed, the finest collection of electrical and machinery exhibits ever assembled under one roof and the exhibitors are co-operating with the Department of Machinery in associating their exhibits with others which will permit of complete operation and demonstration of the working of the various machines and electrical exhibits. On April 1st preliminary work was started on the installation of the first exhibit, a 500 h.p. marine Diesel engine, by the Busch-Sulzer Brothers Diesel Engine Company. The installation will cost $70,000.

The entrances to the Palace of Machinery will be handsomely decorated with palms and shrubs which will afford a pleasing surprise to those who may expect to find only a dry display of pieces of machinery. To attract the non-technical visitor many spectacular exhibits have been arranged and it is believed that the Palace may be made the most popular of the exhibit buildings. Several of the exhibitors have arranged, through the operation of pumps, etc., beautiful and artistic effects, such as water-falls and illuminated fountains.

The latest and most modern-approved methods of illumination will be displayed in connection with the exhibits in the Palace of Machinery and will be of interest to the layman as well as to the student and those vitally interested in such affairs. One phase will be especially interesting; the isolated electric-house-lighting system for farm use compared with the most complicated systems in use for city lighting.

The testing of high-potential insulators and transformers will be made possible by the arrangements which have been made with the largest manufacturers of high-voltage testing apparatus and many spectacular effects have been prepared by the use of such instruments.

A feature of the Palace of Machinery will be the methods employed for the convenience of the visitors. A number of plans are now being tested to ensure engineers and students the opportunity to make a careful examination of each exhibit in privacy and comfort. Reception spaces will be provided in connection with each exhibit and equipped with suitable fixtures which will enable technical visitors to prepare notes on the various features.

All of the working exhibits—and it is now certain that a large percentage will be in actual operation—will be equipped with the latest "safety first" devices and these guards will form one of the most interesting exhibits to the engineer and manufacturer.

The Department of Machinery of the Exposition will soon take formal possession of the offices which have been built inside the Palace on a mezzanine and will remain there until the close of the Exposition. The gates of the Exposition will open on February 20, 1915, and will close on December 4th, 1915. Nine of the eleven principal exhibit buildings are now complete and the others will be finished within 30 days.

Program N. E. L. A. Convention

The annual convention of the National Electric Light Association will be held this year in Philadelphia on June 2, 3, 4 and 5. Following is the program.

Tuesday, June 2

General Session, 10.00 a.m.,—

1. Welcome to the City.
2. Address of President McCall.
3. Announcements.
4. Report of Committee on Organization of the Industry, H. H. Scott.
5. Report of Secretary, T. C. Martin.
6. Report of Insurance Expert, W. H. Blood, Jr.
7. Report of Committee on Progress, T. C. Martin.
8. Report on Question Box, S. A. Sewall.
9. Paper, "Safety First," Paul Lupke.

Technical Session, 2.30 p.m.,—

1. Report of Committee on Meters, P. H. Bartlett.
2. Report of Committee on Grounding Secondaries, W. H. Blood, Jr.
3. Report of Committee on Electric Measures, A. E. Kennelly.
4. Address, "Electric Vehicle," C. P. Steinmetz.

Accounting Session, 2.30 p.m.,—

1. Address of the Chairman of the Section, H. M. Edwards.
2. Report of Library Committee, C. L. Campbell.
3. Report of Question Box Committee, E. C. Scobell.
4. Paper, "Cost and Statistics," Thos. J. Walsh.

Commercial Session, 2.30 p.m.,—

1. Address of the Chairman of Section, T. I. Jones.
2. Report of Finance Committee, E. L. Callahan.
3. Report of Membership Committee, J. F. Becker.
4. Report of Publications Committee, Douglass Burnett.
5. Report of Committee on Education, F. C. Hendershott.

Wednesday

Technical Session, 10.00 a.m.,—

1. Report of Committee on Electrical Apparatus, L. L. Elden.
2. Paper, "Temperature and Its Relation to the Limiting Capacity of Electrical Apparatus," F. D. Newbury.
3. Report of Committee on Underground Construction, P. Torchio.
4. Report of Committee on Overhead Line Construction, Thomas Sproule.

Accounting Session, 10.00 a.m.,—

1. Report of Committee on Rate Research, E. W. Lloyd.
2. Address.
3. Report of Lamp Committee, F. W. Smith.

General Session, 8.00 p.m.,—

1. Action on Report of Public Policy Committee, Arthur Williams.
2. Presentation of Proposed Constitutional Amendments, F. W. Frueauff.
3. Report of Treasurer, W. F. Wells.
4. Election of Nominating Committee.
5. Appointment of Committee on Resolutions.
6. Music.

Public Policy Session, 8.45 p.m.,—

1. Reading of Report of Public Policy Committee.
2. Address.
3. Music.

Thursday

Hydro-electric Session, 10.00 a.m.,—

1. Chairman's Address, W. W. Freeman.
2. Report of Committee on Hydro-Progress, T. C. Martin.
3. The Nature of Electrical Distribution in Transmission Work, D. B. Rushmore.
4. Report of Committee on Distributing Lines, P. M Downing.
5. "Permanent Methods of Measuring Water in Water Power Plants," D. W. Mead.
6. Paper, "Water Power Plant Economics," O. B. Coldwell.

Accounting Session, 10.00 a.m.,—

1. Paper, "Accounting for Merchandise Sold," H. B. Lohmeyer.
2. Paper, "Suspense Accounts," Fred Schmitt.
3. Paper, "Mechanical Auditing and Tabulating Systems,"

(a), "In Connection with Disbursement Accounts," F. A. Birch; (b), "As Applied to Inventory of Transmission and Distribution Systems," G. L. Knight and C. V. Woolsey.

4. Accounting for Coal Consumed, A. L. Holme.

Commercial Session, 10.00 a.m.,—

1. Report of Committee on Non-Peak and High-Load Factor Business, G. H. Jones.

2. Report of Committee on Interurban Lighting Highways, G. B. Tripp.

Technical and Hydro-electric Session, 2.30 p.m.,—

1. Report of Committee on Prime Movers: (a), Steam, I. E. Moultrop; (b), Hydraulic, J. E. Vaughan.

2. Selection of Hydraulic Turbines, Chas. V. Seastone.

3. Report of Committee on Street Lighting, J. W. Lieb, Jr.

4. Report of Committee on Accident Prevention, M. J. Insull.

Commercial Session, 2.30 p.m.,—

1. Report of Committee on Wiring New or Existing Buildings, R. S. Hale.

2. Report of Committee on Electrical Merchandising and Advertising, Parker H. Kemble.

3. Report of Nomination Committee.

4. Election of Officers.

Friday

1. Report of Committee on Award of Doherty Medal.

2. Symposium, "Relations with Geographical Branches of the N. E. L. A."

3. Address, "Plans for Electrical Development," J. M. Wakeman.

4. Report of Committee on Memorials, T. C. Martin.

5. Report of Committee on Constitutional Amendments, F. W. Frueauff.

6. Vote on Constitutional Amendments.

7. Report of Committee on Resolutions.

8. Report of Nominating Committee.

9. Election of Officers.

10. Adjournment.

B. C. E. R. Personals

As previously announced Mr. R. H. Sperling has been promoted by the London board of the B. C. E. R. Company to the position of assistant to the chairman of the board, Mr. R. M. Horne-Payne, and a seat as director of the company. In succession to Mr. Sperling, Mr. George Kidd has been selected for the position of general manager, the appointment to date from May 6th. In assuming his new position, General Manager Kidd stated that the alteration in the post of general manager did not mean any change in the general policy of the company. As far as conditions permitted the company's work would be carried out along the same lines as in the past.

Mr. Sperling the retiring general manager of the company has been associated with its work in British Columbia for 18 years. He started at the foot of the ladder in connection with the company's light and power system at Victoria and mounted every step until he was appointed to the position of electrical engineer. In 1901 he was transferred from Victoria to the company's head office at Vancouver, assuming the duties of general superintendent and chief engineer. In this capacity he gave special attention to the development of the company in the electrical field, showing in this work extraordinary ability in the field of electrical engineer. In 1905 he was promoted to the position of general manager of the company on the retirement of Mr. J. Buntzen as a result of the latter's appointment as a director of the concern. Mr. Sperling will leave British Columbia during July and take up residence in London in connection with his new duties at the company's London offices upon which he will enter about August 1st. The post to which he was promoted is a new one and has been created because of the rapid development of the company's work and the advisability of having an executive at the London office who is fully in touch with the company's operations in its actual field of work. The press throughout the territory covered by the B. C. Electric have unanimously

Mr. George Kidd

expressed through the editorial columns their appreciation of the good work which has been done by Mr. Sperling during his term as general manager of the company.

Mr. George Kidd, the new general manager has been connected with the company's offices both in London and British Columbia. He was appointed secretary to the company in connection with its London work in January, 1908, when he was transferred to British Columbia. He has since been located at the head office of the company in Vancouver,

Mr. W. G. Murrin

filling the position of comptroller. When Mr. Sperling recently left for the old country to personally confer with the London board concerning the promotion which had been offered him, Mr. Kidd was appointed acting general manager during his absence. This action on the part of the London

board foreshadowed the permanent appointment now announced.

Announcement is also made by the British Columbia Electric Railway Company of the promotion of Mr. W. G. Murrin to the position of general superintendent with headquarters at Vancouver. His work will cover the duties of mechanical superintendent, controlling equipment over the company's entire system and the supervision of the Vancouver and suburban division of the street railway system, the most important division on the company's lines. Mr. Murrin came to British Columbia from the old country in 1913 after 13 years' experience as an electric railway executive officer. He obtained his early technical training at Finsbury Technical College, after which he served his apprenticeship in the shops of the Lighting Company of the City of London. After service with the Middlesborough and Stockton Tramway Company he was appointed superintendent of power on the London United Tramways and later promoted to the position of manager of rolling stock and electrical equipment, and works manager in the same company. He then came to Canada to act as mechanical superintendent for the British Columbia Electric Railway.

Electrically Operated Railway Gates

Coincident with their extensive scheme for terminal and dock improvements at Vancouver, the Canadian Pacific Railway Company have installed new electrically operated control railway gates to protect the crossing at Columbia Avenue, North Vancouver Ferry and the approach to the property of the Grand Trunk Pacific Railway Company. The installation was undertaken with the primary object of making the gates self-stopping at certain points.

The initial work of construction consisted of the erection of two 12-in. x 12-in. wooden posts with grooves. The gate runs in these grooves and is raised by two 5/8-in. ropes which pass over pulleys and down to a 12-in. drum in a concrete pit below. This drum is geared to a type M.S. 6 h.p., three-phase, 500 volt, 720 r.p.m. Westinghouse high resistance squirrel cage motor which provides the gates with a speed of 7 feet per minute. The motors have a magnetic brake attached to the shaft, the brake being installed with the object of stopping the gates immediately the power is cut off. Altogether seven of these equipments have been installed.

The controlling centre for all gates is a watchman's tower but at a point which provides an uninterrupted view of their operations. A 3-phase No. 8 lead-covered primary service extends underground from each gate to the tower and is connected to a Westinghouse seven-panel switchboard, each panel equipped with two 2-pole, fifty ampere interlocking magnetic switches, one for upward movement and the other for the lowering of the gate. These switches in turn are controlled by a push button panel board containing twenty-one buttons in all, mounted on a desk-type slate panel, giving the operator a clear view of every button. Three push buttons are required for each gate, one each to operate the movements of the magnetic switch and one to stop at any position. It is necessary to use the stop button only when the gate is in any part way position, as, for instance, when a team may be passing through after the gate has started to come down.

Leading from the control circuit, four No. 14 wires have been carried to two hatchway switches, one at the upper limit and the other at the lower. On the gate is fastened an iron strap about 2 feet long and bowed at each end to engage the limit switch, the limit switch in turn operating the control circuit of the magnetic and arresting the movement of the gate independently of the operator. The latter action is possible only in the direction in which the gate is travelling, the circuit in the other movement still being complete and allowing the operator to move the gate in the opposite direction.

In order to install an electric bell on each gate for the purpose of sounding an alarm before lowering, the push buttons were lengthened for the downward movement, providing two extra contacts which this button engages before engaging the control circuit operating the magnetic system, and therefore making the bells ring first. The bells are style A.A. 30, Railway Supply Company's standard crossing bells, operated by a battery.

The lighting of the gates when lowered is accomplished by placing two copper spring contacts on the groove in which each gate operates and two copper plates on the gates to engage the springs when they reach the bottom, the springs closing the circuit and lighting a 16 candle-power carbon lamp enclosed in a water-tight fitting.

This entire system has just been completed within the last few weeks and is operating successfully. The work of installation was under the direct supervision of Mr. H. C. Chambers, chief electrician of the Canadian Pacific Railway, British Columbia division.

Mr. Parent's Report

Mr. Parent, superintendent of lighting for the City of Montreal, has submitted to the controllers a report of the cost of a municipal plant for the central districts. The capital expenditure is put at $172,667, and the annual operating expenses at $54,100, bring the cost per lamp to $108 per annum. The report was compiled as the result of a dispute with the Montreal Light, Heat and Power Company as to the cost of lighting streets by means of underground distribution, the controllers considering the price of $156 per lamp per annum asked by the company too high. The increase in cost was due, according to the company, to the short term of six years during which the contract will run, and at a conference, which followed the submission of Mr. Parent's report, the company offered to reduce the price to $96.40 provided the Controllers would extend the period of the contract to 16 years. The price quoted included the entire equipment or $90.98 if the city supplied the standards, and $70.36 if the city supplied the lamps, standards and cables. The present price is $72 per lamp.

Judgment Favors T. E. L. Co.

A judgment of considerable importance has been handed down by Mr. Justice Middleton regarding the rights of the Toronto Electric Light Company in the new sections of the city of Toronto. The judgment states, in effect, that the franchise of the Toronto Electric Light Company gives them the same rights in the newly annexed districts as within the original city boundary lines. It is pointed out that it was the evident intention of the original contract for the company to serve the whole city and that the consent of the city had been given from time to time for the erection of poles and the supply of service in the earlier additions to the old limits. It is intimated in the judgment that the city of Toronto is endeavoring to destroy the business, the purchase of which they are at the present moment considering. The judgment throughout may be considered an unconditional win for the company.

Under the guidance of Mr. R. M. Wilson and Mr. Julian Smith, the engineers, a party of shareholders and others visited the hydro-electric power plant of the Cedars Rapids Manufacturing and Power Company being built at Cedars, P.Q. Over 1,500 men are now engaged in carrying out the contract, which is in the hands of Fraser, Brace and Company. It is expected that water will be let into the canal constructed through the rapids by November 1st.

Insulation Resistance Research

By S. Evershed

During recent years a great deal of valuable research work has been done to increase our knowledge of the properties of insulating materials, yet notwithstanding the progress so made the natural laws governing insulation resistance are but little understood. So little, that if at the outset of this paper a plausible statement were made to the effect that the insulation resistance of an electrical system depended mainly upon the dielectric properties of the insulating materials, it might easily pass unchallenged. Possibly some objectors might be found among those who have to maintain the insulation of electrical plant; for no one who has had much experience of the behaviour of insulation in practice, could fail to be struck by the disparity between insulating materials under test in the laboratory and the same materials under the ordinary conditions of use.

It is, of course, easy to guess that the disparity is generally due to the presence of moisture, and in fact the only insulating materials whose behaviour in use corresponds with their predetermined dielectric properties are those which are non-absorbent. Of the remainder, and they form the majority of the materials in common use, we can only predict that the insulation resistance of any electrical system in which they are used will be governed almost entirely by the moisture they absorb. Everyone knows that insulation resistance decreases on a damp day and recovers during dry weather. It is perhaps not so generally known that in most cases insulation resistance decreases, in a perfectly definite way and almost instantaneously, as the electric pressure upon it is increased, and slowly recovers if the pressure is restored to the initial value or cut off altogether. The connection between these two facts is by no means obvious, yet they are so closely related that if we succeed in explaining one of them we shall certainly understand the other. It is often useful to attempt to explain familiar things; facts which, like the effect of a damp day on insulation, are so natural as to require no explanation—until we begin to think about them.

The effect of moisture, the effect of voltage, the effect of polarity, these and other phenomena commonly met with in insulation have been forced upon the author's attention for many years past, and the pressing need to find answers to the questions that so frequently arise in connection with insulating materials induced him to undertake an experimental research with a view to the better understanding of their behaviour in everyday use. This work has been in progress for three years, most of the time being spent in finding a firm basis for future work. But certain experiments have already thrown some light on matters which have hitherto been obscure, and the object of this paper is to render the knowledge so gained available for all those who are interested in the insulation of electrical plant. The specialist will find herein much with which he is well acquainted; but insulation largely concerns those who have no special knowledge about it, and on that account many things have been introduced into this paper in order to give a general view of the subject.

What is the margin between the working voltage and breakdown? That is the fundamental question at the root of every inquiry into the properties of insulation. If a definite answer is ever forthcoming, it will not have been found in "blind" tests of breakdown voltage. To conduct tests without any means for ascertaining what is going on in the insulator as the breakdown voltage is approached, without either observing the current or, better still, the resistance, is to shut our eyes and deliberately avoid looking for the cause of failure. The author has therefore sought, by investigating the nature of leakage conduction, to establish some definite relation between applied potential difference and insulation resistance. If the curve expressing this relation be traced from a few volts up to the breakdown point, it will be found to consist in general of two parts of opposite curvature more or less like the voltage-resistance curve shown in Fig. 1. The two parts of the curve will be joined together by an approximately straight line, the length of which varies greatly according to the nature and condition of the insulation. This connecting link is sometimes so short that the two parts of the curve appear to meet at a point of inflexion and they then form a sort of ogee curve.

The research had not proceeded very far before it was realized that the shape of the first part of this characteristic curve is determined by the extent to which leakage is due to moisture, and further that leakage through the substance of the insulator—dielectric leakage—was negligibly small compared with that caused by the merest trace of moisture. This leads to the point of view that for most practical purposes an insulator may be regarded as having no inherent conductivity, the conducting power which it appears to possess being usually caused by leakage over damp surfaces. If the insulator is porous then the leakage surfaces are not only those outside the insulating body but those surfaces which bound the maze of capillary channels inside the porous material. If this idea be provisionally accepted at the outset the facts brought out by the experiments will be found to fall easily into their places, and a fairly consistent view of leakage conduction will be obtained. The research divided itself quite naturally into two parts corresponding to the two significant parts of the characteristic curve. The investigation of the second or breakdown part of the complete curve (see Fig. 1) is still in the preliminary stage, and the present paper deals mainly with the first part up to the point or region of inflexion.

Summary and Conclusion

This vision of what goes on inside an absorbent insulator, misty and imperfect as it is, provides an explanation in general agreement with the facts. In putting it forward the author is conscious of difficulties and obscurities which leave the mind doubtful, but the doubts are just those which come from ignorance of the precise structure of absorbent bodies and the mode in which they harbour moisture. In all probability the microscope would dispel a good deal of this cloud of ignorance if it were applied to some typical material like a thread of cotton.

But the facts which have emerged from the investigation leave no room for doubt as regards the main characteristics of insulation resistance under working conditions.

The true dielectric resistance of insulation is enormous compared with the actual insulation resistance obtained in practice, and in all ordinary cases we need only consider the leakage which takes place through films of moisture condensed on the external and internal surfaces of the insulating material. Dielectric leakage is insignificant and may be left out of account.

The quantity of water in the conducting films of moisture is not only very small, but it forms an exceedingly small proportion of the whole volume of absorbed water.

Impregnating an absorbent insulator with oil or varnish delays the absorption of water and no doubt limits the amount absorbed, but it does not prevent the ultimate formation of the moisture films which constitute leakage paths.

Conduction through absorbent insulation does not follow Ohm's law. The relation between the resistance of an absorbent insulator and the potential difference which is applied to it is expressed by a curve which is characteristic of conduction by films and drops.

When the absorbed water exceeds the amount which the material can hold in the form of dormant water and leakage films it begins to form conducting paths of constant resistance. Hence the moisture curve gradually decreases in curva-

ture as absorption goes on, and ultimately when the resistance has fallen to a very low value the curve is reduced to a horizontal straight line, indicating conduction by Ohm's law.

In compound insulation consisting of an insulator in which conduction follows Ohm's law, in series with an absorbent material which follows the law of moisture conduction, the resultant curve has less than the normal curvature.

The degree of curvature in the characteristic curve of compound insulation enables the resistances of the two components to be separately estimated.

In compound insulation a curve of normal curvature indicates failure of the dielectric component. A straight horizontal "curve" (Ohm's law) indicates failure of the absorbent component.

Finally, the broad principle of film conduction in an absorbent insulator is clear; the moisture curve—the first part of the complete characteristic curve—is the direct result of electric endosmose. The electrically produced hydraulic pressure drives dormant water into the films, and their increasing thickness is made evident by the gradual fall in resistance as the potential difference is increased.

At what point leakage through moisture becomes dangerous; whether the ultimate effect of prolonged endosmosis is to safeguard the insulation by driving all the water away from the positive conductor in a continuous-current system, and from both conductors if the supply is by alternating current; whether it is possible to predict the breakdown voltage —these and other questions can only be answered by an investigation of the second part of the characteristic curve. Preparations for this are not yet complete, and so far it has only been possible to extend the curve to the breakdown point in one or two simple cases for which the voltage already available proved sufficient. In these examples the curve began to bend downwards at pressures well below the breakdown value, thus indicating the impending failure without exposing the insulation to the risk of permanent injury. It remains to be seen whether this useful effect is general, or whether, as seems more probable, it is confined to insulating materials in which failure begins along already existing leakage channels. It is a significant fact that in the model insulator breakdown begins in the form of sparking along the films from one drop to another. Questions of this kind go to the very root of the matter. It is customary to account for breakdown by dielectric stress; a blackened hole appears in the insulation and the inference is too hastily drawn that the puncture process was instantaneous and could not have been foreseen by any kind of test. But nothing in Nature, not even an explosion, takes place instantaneously, and the breakdown of an insulator is only sudden to the mind that does not apprehend it.

The time may never come when it is possible, by systematic insulation testing, to forestall breakdown by diagnosis of the disease and removal of the cause. To-day the problem as a whole looks wellnigh insoluble, and with no visible goal ahead of us we must be content to gain a clearer insight as we go along in more or less the right direction.

Personal

Mr. R. M. Hannaford, assistant chief engineer, Montreal Tramways Company, has been elected second vice-president of the Canadian Railway Club.

Mr. F. A. Gaby, chief engineer, Hydro-electric Power Commission of Ontario, was married on May 20 to Miss Catherine Florence Macbeth, Toronto.

Mr. W. J. Camp, assistant manager C. P. R. Telegraphs, was present at the annual meeting of the Association of Railway Telegraph Superintendents held at New Orleans.

Mr. S. W. Canniff, formerly on the staff of the Canadian General Electric Company, has been placed in charge of the meter department and transformer tests of the Ottawa Municipal Electric System.

Cost of Electricity at the Source

By H. M. Hobart[1]

By the time electricity is delivered on the premises of small consumers such considerable costs will have been incurred that the price admitting of any profit can rarely be less than some where from two cents to eight cents per kelvin.[2] The original cost of manufacturing in bulk, however, is a far less amount. It is desirable that this should be more generally realized as it indicates the great field for electricity for large manufacturing enterprises which can be located near the source of electricity supply. Under favorable conditions electricity can be manufactured in bulk at a cost of the order of 0.25 to 0.40 cent per kelvin.

In an address delivered by Ferranti in 1910, the proposition was formulated that, on certain assumptions, a station equipped with ten 25,000 kw. generating sets could be built at a total cost of $35 per kilowatt. I have made estimates which indicate $35 per kilowatt to be sufficient for a 100,000 kw. station equipped with five 20,000 kw., 1,800 rev. per min., steam turbine driven, three-phase generators and all the machinery required in such a plant. As a matter of interest it may be stated that the outlay for the turbo-generators, cables, exciters, and switchgear is covered by 30 of this $35 per kilowatt. (In and near large cities this sum would be insufficient, since the outlay for land and buildings would then be at least $10 per kw.).

The following estimate for the cost of electricity when manufactured in such a station, will be based on the Stott-Gorsuch method, in accordance with which the total cost is considered as made up of three components. These three components are:

1. Production Costs.
2. Investment Costs.
3. Administration Costs.

I shall divide the Production Costs into two items, A and B.[3]

Item A relates to all components of the Production Costs except fuel. Item B relates to the cost of fuel. While A will vary by a small amount with the load factor, I shall neglect this variation and take:

Item A = $700,000[4]

Item B: In estimating the annual outlay for fuel we must first have data for the overall efficiency of the station. From an examination of the thermal efficiencies of turbo-generating sets and steam raising plant, one would be led to expect overall efficiencies from the coal to the outgoing cables ranging from at least 18 per cent. for unity load factor down to at least 16 per cent. for a load factor of 0.50. But reasoning from the results actually obtained in practise it is not considered that it would be conservative to take values higher than the following:

Load factor	Overall efficiency
1.00	15 per cent.
0.75	14 per cent.
0.50	13 per cent.

Assuming the maximum load from our 100,000 kw. station to be 80,000 kw., the annual output for these three cases is:

Load factor	Annual output in mega-kelvins
1.00	700
0.75	525

1. Read before the A. I. E. E.
2. In this paper the term kelvin is employed instead of the term kilowatt hour.
3. Item A covers wages, repairs, lubricants, water, supplies, etc.
4. It is believed that an analysis will show this value to be reasonably representative for Item A and that in so far as it errs it is in the direction of being conservative. It will cover any investment costs, associated with the water supply, such as cooling towers when required.

0.50	350

The energy in the coal consumed per annum amounts to:

Load factor	Mega-kelvins of energy in the coal
1.00	4660
0.75	3750
0.50	2690

The estimates may be based on coal with a calorific value of 12,000 B.t.u. per pound. 1 kelvin equals 3,411 B.t.u. Consequently each (2,000-lb.) ton of coal contains:

$$\frac{12,000}{3411} \times 2,000 = 7,000 \text{ kelvins}$$

The quantity of coal burned per annum is as follows:

Load factor	Quantity of coal burned per annum
1.00	667,000 tons
0.75	535,000 tons
0.50	384,000 tons

In the following table are set forth the outlays for fuel on the basis of 50 cts. per ton and $5 per ton.

Load factor	Annual Outlay for Fuel 50cts. per ton	$5 per ton
1.00	$334,000	$3,340,000
0.75	268,000	2,680,000
0.50	192,000	1,920,000

The above amount represents Item B, the fuel component of the production costs per annum. We have already stated that for the remaining component of the production costs, (Item A), we shall take the constant value of $700,000.

Adding A and B we obtain the total production costs set forth in the following table.

Load factor	Production Costs per Annum: Fuel at 50 cts. per ton	Fuel at $5 per ton
1.00	$1,034,000	$4,040,000
0.75	968,000	3,380,000
0.50	892,000	2,620,000

In terms of cents per kelvin, the above production costs are:

Load factor	Production Costs per kelvin: Coal at 50 cts. per ton	Coal at $5 per ton
1.00	0.148 cent	0.576 cent
0.75	0.184 cent	0.645 cent
0.50	0.254 cent	0.750 cent

We now come to the second component of the total cost, namely the investment costs. At $35 per kilowatt the initial cost of the 100,000 kw. station is $3,500,000. This is sufficient to cover engineering supervision and contingencies.

On the basis of:

Interest	5.0 per cent.
Rates, taxes and insurance	3.0 per cent.
Amortization	4.6 per cent.
Total annual charge on investment[5] ..	12.6 per cent.

we arrive at an Investment Cost per annum of

$$0.126 \times 3,500,000 = \$441,000.$$

In terms of cents per kelvin the Investment Costs are.

Load factor	Investment costs per kelvin
1.00	0.063 cent.
0.75	0.084 cent.
0.50	0.126 cent.

As to the final item in the total cost, namely the administration costs, let us distinctly limit this item to the bulk manufacturing undertaking. Let the marketing of the electricity be separately handled by another undertaking. With this understanding, an allowance of $100,000 per annum is reasonable for administration costs. This provides for an administrative organization simply concerning itself with manufacturing the electricity and delivering it at the outgoing cables. Per kelvin, this amounts to:

Load Factor	Administrative Costs per kelvin
1.00	0.014 cent
0.75	0.019 cent
0.50	0.029 cent

The total costs are worked out in the following table in which production costs are indicated by I, investment costs by II, and administration costs by III.

Load Factor	Component and Total Costs in Cents per kelvin: Coal at 50 cents per ton	Coal at $5 per ton
1.00	I = 0.148 cent II = 0.063 " III = 0 014 " Total = 0 225 cent	I = 0 576 cent II = 0.063 " III = 0 014 " Total = 0 653 cent
0 75	I = 0 184 cent II = 0.084 " III = 0.019 " Total = 0.287 cent	I = 0 645 cent II = 0 084 " III = 0.019 " Total = 0 718 cent
0 50	I = 0 254 cent II = 0.126 " III = 0 029 " Total = 0 409 cent	I = 0 750 cent II = 0 126 " III = 0 029 " Total = 0 905 cent

These total costs are plotted in Fig. 1 with cost of coal as abscissas. They are plotted in Fig. 2 with load factors as abscissas.

For water power stations, if there is no charge for the water, and if the total investment can be kept as low as $35 per kilowatt, the lowest curve in Fig. 2, (i.e. the curve for fuel at a negligible cost per ton) may be taken as affording a fair

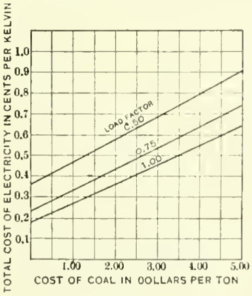


Fig. 1

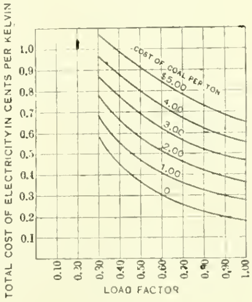


Fig. 2

indication of the cost of electricity at the source.

This investigation has been based on the assumption that the electricity delivered from the station is of unity power factor. For lower power factors the total cost of the electricity will be higher. Professor Arno of Italy has devoted a great deal of study to the influence of the power factor on the cost of electricity and has arrived at the conclusion that for practical purposes the cost may be taken as proportional to two-thirds of the true output, plus one-third of the apparent output (i.e., the true output divided by the power factor). Thus if we take the case of our 100,000-kw. station when the load factor is 0.50, we have seen that the cost, with coal at 50 cents per ton, is 0.409 cents per kelvin

5. For other capital costs per kw. and for other rates and other depreciation assumptions the corresponding annual investment costs are readily deduced. Those adopted in this investigation would appear representative for such a station.

for unity power factor. If the load is of 0.80 power factor the cost by the Arno rule will be:

$$\left\{ 0.667 + \frac{0.333}{0.80} \right\} \times 0.409 = 0.444 \text{ cent. per kelvin}$$

Prof. Arno's rule may be regarded as a useful approximation for representative conditions. The application of the present method of analysis to outputs of different power factors would show that no such simple rule would suffice. The influence of the power factor would for instance be much affected by the ratio of the cost of fuel to the total costs, and would be different with different load factors.

Indeed a similar general criticism applies to Mr. Stott's nevertheless useful approximate rule that the production costs may be taken as inversely proportional to the fourth root of the load factor. There may be wide deviations from such a rule occasioned by extremes in cost of fuel and in other conditions.

Furthermore the costs which we have worked out have related to delivering 60-cycle three-phase electricity at the pressure at which it is generated, say 10,000 volts. If it is to be stepped up to, say, 100,000 volts, to be transmitted in bulk to a distance, then the cost at the high-pressure side of the step-up transformers may be obtained as follows:

Let us take the case of a load factor of 0.50 and coal at 50 cents per ton. Let the power factor be unity. The cost under these conditions has been estimated to be 0.409 cent per kelvin. We shall require to provide step-up transformers with an aggregate capacity of 100,000 kw. Their cost would be of the order of $2.70 per kilowatt making a total outlay of $270,000. The annual outlay for interest, rates, taxes, insurance, amortization, repairs and attendance may be taken as:

$$0.15 \times 270,000 = \$40,500.$$

The annual output from the station when the load factor is 0.50 has already been estimated to be

350 mega-kelvins.

Taking the annual overall efficiency of the transformers as 97.5 per cent. the output from the transformers is

$$350 \times 0.975 = 341.5 \text{ kelvins.}$$

Therefore the step-up transformer costs, per kelvin delivered from them, are

$$\frac{4,050,000}{341,500,000} = 0.012 \text{ cent.}$$

The total cost per kelvin delivered from the step-up transformers is

$$\frac{350.0}{341.5} \times 0.409 + 0.012 =$$

$$0.419 + 0.012 = 0.431 \text{ cent.}$$

Thus the cost has increased 5.5 per cent. by the time the pressure has been stepped-up. This paper is entitled "The Cost of Electricity at the Source." By similar processes, however, the increases in cost can be traced right through to the consumers' premises. But the reasoning becomes very involved when we arrive at the stages where the electricity is no longer carried in bulk. At these stages questions relating to appraisements of value, diversity factor, ethics and commendable sentiment render it impossible to arrive at any precise method which can be conclusively demonstrated to provide for equitably distributing the total cost amongst the various consumers.

At the last meeting of the Montreal Electrical Society Mr. C. O. Von Dannenberg, of the engineering department, Montreal Public Service Corporation, read a paper on "General Notes on 66,000 volt Electrical Construction." Mr. Von Dannenberg dealt especially with sub-station work, and discussed the relative merits of different types of equipment.

Light and Power in Edmonton

Although the year 1913 was one of financial depression it would appear from a perusal of the report of the Electric Light and Power Department of the city of Edmonton, that that department was not affected by the prevailing conditions, since this report shows that the department experienced the best year it has yet had. The figures given below are extracted from the report and give a comparison between the years 1912 and 1913:

	1912 12 months	1913 11 months	% increase
Revenue from private lighting	$285,168.72	$544,583.54	91
Revenue from power	42,404.32	90,537.17	113.5
Revenue from street lighting	26,171.40	60,736.77	132.1

During the year there were issued 6,505 wiring permits as against 5,102 in 1912, an increase of 27.5 per cent. approximately, and there were connected up 3,514 lighting consumers and 112 power consumers during the year, which brought the total connections up to 11,052 and 373 respectively as against 7,538 and 252 at the end of the 1912 financial year, increases of 46.6 per cent. and 48 per cent. respectively. Considerable work was also done in extending the street lighting. At the end of 1912 there were in operation 477 arcs and 45 tungstens and during 1913 there were installed 331 arcs and 55 tungstens. Included in the total of arcs are 84 inverted C. G. E. magnetite lamps as part of a "White way" scheme, which scheme is now being completed and is further described below. During the year the meter section handled 11,152 meters, as against 7,190 handled during 1912, an increase of 55 per cent.

The figures given above are indicative of the rapid development that the capital city of Alberta has made and this is still further illustrated graphically in the accompanying curve which represents gross revenue.

It is hoped at an early date this year to complete a "White way" installation consisting of 178 C. G. E. magnetite inverted arc lamps on standards. These standards will be installed in the business sections of the city. When this work is completed the city will have a total of 262 inverted lamps in use, with a possibility of this total being added to in the near future.

The Department has also installed a lighting system on the traffic deck of the High Level Bridge which connects both sides of the river. This bridge has two decks, the upper one carrying three tracks, two being for the street railway and the other for the C. P. R. Foot passengers and vehicle traffic is provided for by a lower deck and this has been lighted by installing 76 two-light tungsten standards, set so that one light projects beyond the steel work on to the footpath and the other on to the roadway. These standards are installed on both sides of the bridge and are staggered at as uniform distances as the bridge structure would permit. Sixty c.p. 6.6 amp. series tungstens are used, each lamp being enclosed in a 12-in. Alba globe. The resulting illumination is even throughout the whole length of the bridge. The approaches are lighted by inverted C. G. E. magnetite arcs (6.6 amp.) mounted on Parkway standards.

For the last week in May, May 25th to 30th inclusive, the Department has initiated a campaign to increase its day load, by encouraging the use of heating and cooking appliances. In this campaign it has received the active co-operation of all the electrical contractors and those hardware and department stores which handle these appliances. An electrical show, which will continue throughout the week, will be held in a building designed for the purpose which is on one of the principal corners in the city. Demonstrations will be made and no expense spared to make the show one which will appeal to all. It is hoped to make this exhibit one of the most attractive ever held in Western Canada, and it is the

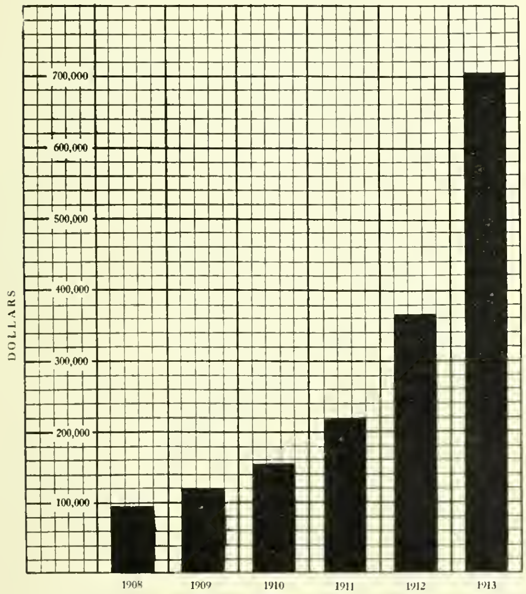
department's intention to continue the campaign throughout the summer.

Since the beginning of the present year there has been a revision of the rates and a re-classification of consumers, the rates now being as follows:—

Domestic Lighting—7½c for the first 100 kw.h.; 101 to 400 kw.h., 7c; 401 to 1,000 kw.h., 6½; 1,001 to 2,200 kw.h. 6c; 2,200 kw.h. and over, 5½c. Minimum charge per month to be 75c. Discount of 5 per cent. if paid within ten days from date of bill. No discounts allowed on accounts of less than $1.00.

Power—6c per kw.h. for the first 150 kw.h.; 150 to 300 kw.h., 5c; 301 to 5,000 kw.h., 3c; 5,001 and up, 2c per kw.h. Minimum charge on motors up to 15 h.p., 75c per h.p. per month on total connected load. Minimum charge on motors above 15 h.p., 50c per h.p. per month on total connected load. Ten per cent. discount allowed on all accounts exceeding $1.00. No bill issued for less than the following amounts,—single-phase connections 75c per month; three-phase connections $2.25 per month.

Domestic Appliances in private residences and not used for commercial purposes, such as heating, ironing, cooking



Gross earnings, Edmonton's light and power department.

and small single-phase electric motors up to 2 h.p. total connected load—4c per kw.h. A minimum charge of 50c per kilowatt connected will be charged per month. Discount of 5 per cent but no bills isued for less than $1.00 per month.

Mercury arc rectifiers for battery charging or business purposes (other than moving picture machines); arcs for blue print machine and photographic purposes; heating and ironing for commercial purposes in laundries, pantoriums or other business premises, also in public schools; medical apparatus of 1 kw. or larger capacity; single-phase motors where the total connected horse-power does not exceed 3 h.p.,—5c per kw.h. for the first 375 kw.h.; 375 to 5,000 kw.h., 3c per kw.h.; 5,001 kw.h. and up, 2c per kw.h. A minimum charge of 50c per kw. or horse-power connected will be charged per month. Discount of 10 per cent. Minimum bill $1.000 per month.

Moving Picture Machines—(Arcs or Rectifiers) rate 6c per kw.h. Minimum charge $3.00 per month. Ten per cent discount.

Grounded Neutral Experience*

By J. P. Jollyman, P. M. Downing and F. G. Baum

The Pacific Gas and Electric Company operate a very extensive 60 cycle transmission network in Central California. The 60 kw. system comprises about 1,260 miles of three-phase circuit. It is supplied directly by nine hydroelectric plants having an installed generator capacity of 67,310 kw. and three steam plants having an installed turbo-generator capacity of 68,000 kw. In addition there are 14,300 kw. of steam engine-driven generators in the company's steam plants which are held in reserve. The 100 kv. system which has just been put into operation has one hydroelectric generating station of 25,000 kw. capacity and 109.5 miles of circuit. The entire output is fed into the 60 kv. system through one substation.

For the purpose of the receipt or delivery of power the 60 kv. system is connected as follows: at Chico to the 60 kv. system of the Northern California Power Company; at Santa Rosa with the 60 kv. system of the Snow Mountain Water and Power Company; at a point near Folsom with the 60 kv. system of the Western States Gas and Electric Company; and at Oakland, through transformers, with the 100 kv. system of the Great Western Power Company.

These connections very considerably increase the length of circuit and total generator capacity connected to the 60 kv. system. The entire 60 kv. and the 100 kv. systems are usually operated in parallel.

The transformers at all the company's own generating stations and at all important substations have their high-tension windings Y connected with the neutral solidly grounded. The low-tension windings of the generating station transformers are nearly all delta-connected as are also about half of the substation transformers. The remaining substation transformers have both windings Y connected with solidly grounded neutrals. In most of the substations where the low tension windings are delta-connected, a switch is provided between the high-tension neutral and the ground, which is normally kept open. This avoids the short-circuiting of one transformer in case of a ground on the transmission system and prevents the substation being cut off from the system by the opening of the protective devices on the high-tension side of the transformers. There are over 225,000 kw. of 60 kv. transformer capacity in the company's own generating plants and substations.

The Northern California Power Company, the Snow Mountain Water and Power Company and the Western States Gas and Electric Company operate their transformers Y connected with the neutrals solidly grounded. The connection with the Great Western Power Company is through transformers connected delta to delta. This method of connection is not theoretically correct where power is to be fed from the delta-connected transformers into the grounded Y system, because a ground on one wire of the line connecting the delta-connected source of supply with the grounded Y system will impress 173 per cent. of normal voltage across the high-tension windings of two of the transformers in the grounded Y banks. The resulting disturbance in the low-tension circuits is very severe. Our experience proves conclusively that this method of connection is not desirable.

At all generating stations, and at all important junction points and substations the 60 kv. lines are controlled by oil switches. The lines are switched out under any condition of load or short circuit as occasion demands. The lines are also switched on at full voltage. We have operated in this manner for over 10 years and have never had any failures of transformers or of line insulation which could be attributed to this method of operation.

We consider that the grounded-neutral system as com-

* Read before A. I. E. E.

pared with the delta system affords the following important advantages:

1. With Regard to Transformers: Transformers are wound for only 57.7 per cent. of the voltage required in the delta system. The average voltage to the neutral from all points of the windings is 50 per cent. of the voltage from line to neutral; that of a delta bank is 69 per cent. The product of the turns times the average voltage to neutral in the Y connected bank is 41.8 per cent. of that in the delta-connected bank. The windings have 173 per cent. the current capacity of the windings of a delta transformer.

In addition there is only one line terminal per single-phase transformer, wiring for a spare unit is much simpler and the high-tension windings may be used as auto-transformers in supplying small amounts of power to lower voltage circuits.

The connection between the Pacific Gas and Electric Company's 100 kv. system and the 60 kv. system is made with auto-transformers connected grounded Y. We believe this to be the simplest, most reliable and most efficient connection than can be made between two such systems.

Our transformers have given so little trouble that we have not had much occasion to try to maintain service with only two transformers. We have had no difficulty, however, in carrying loads up to 2,000 or 3,000 kw. with two transformers.

Our experience confirms our belief that the fewer turns of greater current capacity and the fixed lower average voltage to ground of the transformers greatly increase their reliability.

2. With Regard to Transmission Lines: The maximum voltage on the line insulators is fixed and is never more than 57.7 per cent. of the line voltage. Ten years ago the pin type insulator was the only type obtainable and the low fixed maximum voltage of the grounded neutral system has unquestionably been of great assistance in securing the best service from this type of insulator.

It is possible to maintain polyphase service at a substation on a branch line with only two wires in the event one wire should be cut out. This cannot be done on a delta system unless one phase of the whole system be grounded and this is very undesirable.

3. With Regard to Operation: With the neutral grounded, a wire down is instantly detected and power must be immediately cut off. This is exceedingly important where many of the circuits run through thickly settled districts. Inasmuch as practically all our important loads are reached by two lines or are on a loop, service is not more than momentarily interrupted by a failure at one point.

A line of any length may be charged at full voltage without shifting the static neutral. It is impossible to close all phases of a circuit at exactly the same instant. In a delta system the first phase closed will increase the capacity to ground of that phase of the system and thereby draw the static neutral toward that phase. The second phase acts in a similar manner and the static neutral does not return to the center of the delta until the three phases are closed. This sudden shifting of the static neutral is the cause of an unnecessary strain on the insulation of the system. We know of failures from this cause on delta-connected systems.

Finally, and most important of all, is the fact that in extensive high-voltage delta-connected systems a ground is often followed by a disturbance of such power that breakdowns of insulation at other points take place. Such a disturbance generally results in serious damage to apparatus and service. The cause of this type of disturbance is found in the oscillatory character of the arc which takes place from a delta-connected system to ground, together with a large amount of current which will flow in such an arc if the system is extensive. In the event of a ground on a delta connected system, the charging current, which is a function of the voltage from wire to neutral, will be increased because the neutral is shifted from the center of the delta to one corner. This increase will be about 73 per cent. The current flowing in the arc to ground may be nearly equal to the increased charging current, and this on our 60 kv. system would amount to about 400 amperes. The circuit containing the arc, line reactance and capacity from line to ground tends to oscillate. Such an oscillating arc is very likely to set up disturbances of high power especially when there is any such current as 400 amperes involved. We have seen evidence that such a disturbance may cause high voltage to ground on the wire on which there is an arcing ground. This fact would probably cause the operation of an arcing ground suppressor to be very unreliable.

Certain districts in which we operate occasionally have heavy fogs which are carried in from the Pacific Ocean by the prevailing westerly winds. It has been our experience in these districts that lines on pin insulators have given better service when operated grounded Y at 60 kv. than when operated delta-connected for a much lower line voltage. It seems probable that the leakage over the insulators in foggy weather was sufficient to set up oscillatory disturbances which caused more trouble than has the higher but more stable line voltage.

We have found that the grounded Y system is entirely free from such disturbances as these. The frequency of an arc to ground is that of the system. Any damage is confined entirely to the point of failure. The short-circuit currents have not caused any damage to generator or transformer windings. Due to the distribution of the sources of power, any given point on the system will have a good many miles of line between it and several of the generating plants. Hence it is doubtful in many cases if more current would flow in a short circuit to ground than would flow to ground if the system were delta-connected. The drop over the lines from the more remote generating plants to a point at which a ground may take place serves to prevent the voltage at points removed from the trouble from dropping to zero, and therefore the service is not seriously interfered with except in the vicinity of the trouble.

We believe that the operation of our system with the neutral grounded causes less disturbance in the circuits of our neighbors, the telephone and telegraph companies, than would be the case if we operated delta-connected.

Briefly, the induction in parallel telephone or telegraph circuits is caused by any unbalanced currents in the phases of the high-tension circuit, and by the presence of voltage to ground on the line conductors. The last cause is by far the most important because the unbalanced currents during normal operation may be kept very small while the voltage to ground is always high. A ground on the grounded Y system will not cause much, if any, more current unbalanced than will a ground on a delta-connected system. The unbalanced current is at normal frequency in the grounded Y system in place of at a very much higher frequency as is usual on the delta-connected system, hence the parallel circuits are not affected so unfavorably. It is our experience that even a considerable amount of unbalanced current at the normal 60 cycle frequency has little noticeable effect on parallel telephone circuits. The unbalance will be immediately removed from the grounded Y system in all cases, whereas a delta-connected system may occasionally be operated a short time with a ground before a final shut-down takes place. The definite limit on the voltage to ground is of very great advantage to the parallel circuit.

Conclusion

The operation of our high-tension network with the grounded neutral has been entirely satisfactory. We do not believe that we could give as good service, with as high a degree of safety to the public with any other system.

The Motor-Converter---Theory and Practice

By W. A. Coates, A. M. I. E. E.

[The motor-converter is now finding its way into the Canadian field. Regina has been operating a 1,200 kw. unit since February 26 of the present year, the Canada Cement Company are installing a 250 kw. unit and the Armstrong-Whitworth Company, Montreal, have placed an order for two 350 kw. machines. In the August 15, 1913, issue of the Electrical News there appeared a brief description of this type of equipment explaining its relation to the rotary converter and the motor-generator. In view of the continued interest in these machines we are glad to be able to print a somewhat more complete description of the theory and design of the motor-converter.—Editor.]

The first commercial Peebles-La Cour motor-converter was built in Edinburgh in 1904, the covering patents having been granted to Messrs. Bragstad and La Cour some two years previously. Since that time, machines of this type have been built to a total of a quarter of a million kv.a. in Edinburgh alone.

In general construction, it may be said that the motor-cōnverter is a combination of an induction motor-generator and a rotary converter. It consists of two machines rigidly coupled as in the motor-generator, the rotor of the a.c. end being also electrically connected with the armature, and hence the commutator at the d.c. end, thus following the rotary converter. In Fig. 1 is shown a diagram of connections.

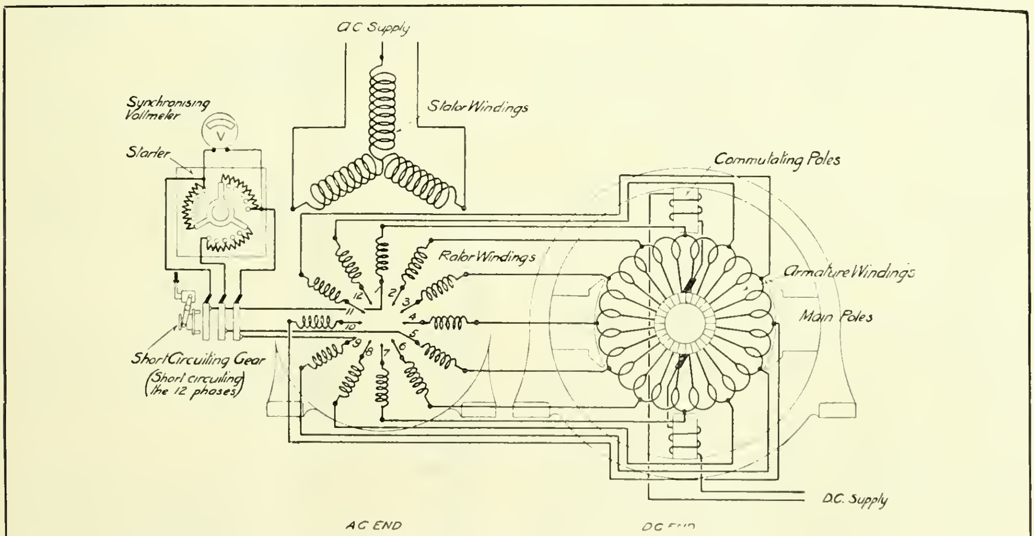


Fig. 1.—Diagram of connections of La Cour Motor-Converter.

The stator of the a.c. end is wound for direct connection to the supply system. As there is no electrical connection between this and the d.c. end, the voltage for which the stator may be wound is only limited by the same considerations of insulation as affect the design of any h.t. motor. The rotor of the a.c. machine is usually wound with twelve phases which are connected at one end to corresponding points on the armature of the d.c. machine. Three of these phase windings are connected at the other end through slip rings to a starting resistance, and all twelve windings are also brought at this end to a short circuiting device, which forms the neutral point when running. The d.c. field is in every way similar to that of the ordinary d.c. machine.

Let us assume for the moment that the a.c. and d.c. ends have both been wound for the same number of poles and that the rotating element is running at half the synchronous speed for a conventional motor with that number of poles. The stator winding will induce in the rotor of the a.c. end a revolving field which rotates relatively to the rotor itself, at a speed which corresponds to half the frequency of the supply, and the e.m.f. induced in the rotor will also be of half supply frequency. The number of poles in the d.c. field being the same as for the a.c. end, it follows that the e.m.f.'s in the d.c. armature will be of the same frequency as those in the a.c. rotor, when running at the speed assumed.

If now the windings of the a.c. and d.c. rotors be paralleled, the combined set will hold this speed, and will behave as a single synchronous machine.

In order that this may be the case, the e.m.f.'s induced in rotor and armature must balance each other. This effect is obtained by so interconnecting them that the rotor currents in flowing through the armature produce a flux which rotates in the opposite direction to the shaft, and which consequently has no motion relative to the d.c. field. It is the action between these two fields which holds the set to speed, as any variation in speed involves a relative displacement between the two fields, and sets up synchronising currents.

As the rotor revolves at a speed corresponding to half the frequency of supply, half the electrical energy supplied to the a.c. end will be transferred without change (save of voltage) through the rotor winding to the d.c. armature, and the balance will be converted into mechanical energy, and transmitted through the shaft to the d.c. armature, where it is re-generated into electrical energy. The a.c. end is therefore employed half as the transformer supplying a rotary,

and half as the motor of a motor-generator set, while the d.c. end acts half as a rotary-converter and half as a d.c. generator.

The size of the a.c. machine depends on the speed of the rotating field, and not on that of the rotor, and consequently the machine may theoretically be built only half the size of a simple motor of like total kw. capacity and speed. The d.c. end may also be reduced in size below that of a similar d.c generator, by reason of the more favorable commutating

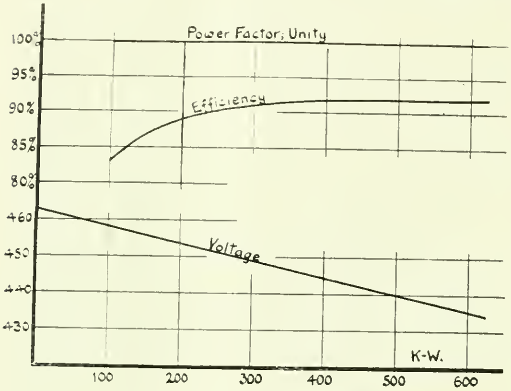


Fig. 2.—Characteristics of 500 kw. lighting unit.

conditions. In actual practice, it is usual to design these machines with a greater number of d.c. poles than a.c. so as to obtain a still further reduction in size. In this case the machine will run at a speed inversely proportional to the sum of the poles of both machines. The speed is given by the formula:—

$$\text{r.p.m.} = \frac{60 \times \text{supply frequency}}{\text{a.c. poles} + \text{d.c. poles}}$$

Under these conditions the a.c. end will convert mechanically:—

$$\text{kw.} = \frac{\text{a.c. poles} \times \text{kw. capacity of set}}{\text{a.c. poles} + \text{d.c. poles}}$$

The balance of the energy will be transferred from the a.c. to the d.c. end electrically as in a rotary.

In starting up these machines from rest, the stator winding is switched straight on to the a.c. supply three of the rotor phase windings being connected through slip-rings to a non-inductive resistance, and the remaining phase winding left open-circuited. The d.c. end is disconnected from the bus bars, and has its field connected in shunt for self-excitation. As the non-inductive resistance is cut out, the set comes gently up to speed, just as a slip-ring induction motor would do. As the speed approaches synchronism the rotor and armature e.m.f.'s will be alternately in unison and opposition, and a volt-meter connected across two of the slip-rings will show this condition. When the set actually attains synchronism, this instrument will cease to show any fluctuation, but will remain at zero. The starter is cut out, and the short circuiting device is closed, thus forming the common star point for all the rotor phase windings. The d.c. shunt rheostat is usually left with some resistance in, so that the set at first comes up to slightly above synchronous speed, and then automatically drops very slowly into step.

The exact proportion of shunt resistance necessary is settled when the machine is first started up. Thereafter no adjustment is required, the operator merely waiting for the voltmeter to indicate the moment to cut out the starter entirely. The simplicity of this method of start, as compared with the starting up of a synchronous motor-generator or rotary converter is very marked.

The motor-converter can be run inverted, i.e., d.c. to a.c., in which case starting from the d.c. end is accomplished with an ordinary d.c. starter, and the a.c. end is synchronised with the running plant just as would be the case with any incoming alternator unit.

When intended for use on traction systems, the d.c. machine can be compounded to give a rising characteristic, this being a distinct step in advance of the rotary converter, where over-compounding can only be obtained by using an external reactance.

The power-factor characteristics of this machine are also very interesting. A flat compounded or simple shunt machine is generally designed to give a power-factor of practically 100 per cent. at all loads, while with a rising compound winding the p.f. changes from lagging at no load and light loads, through 100 per cent. at about ¾ load, to leading at full and overload, see Figs. 2 and 3.

One of the principal features which has influenced the use of synchronous motor-generators on long distance transmission systems hitherto has been the fact that such machines can be used for power-factor correction. The extent to which such compensation can be obtained on a La Cour converter is indicated by the regulation curve Fig. 4. At periods of light load when all the machines in a sub-station are not required to handle the service, spare motor-converters may be run up with the d.c. end disconnected, and by shunt regulation can be utilized as synchronous condensers.

The efficiency of the motor-converter is considerably higher than that of a motor-generator. It is slightly less

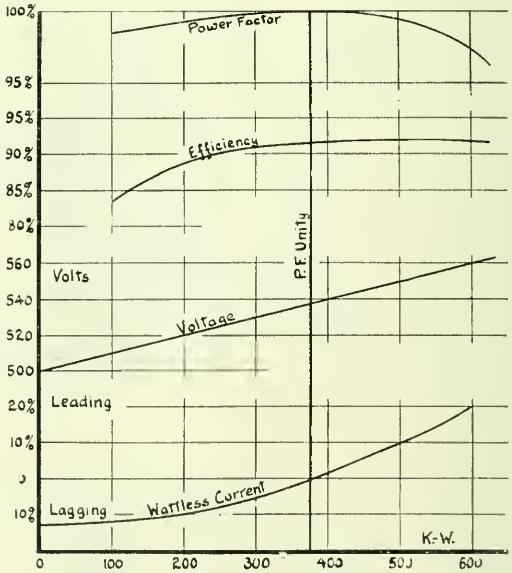


Fig. 3. Characteristics of 500 kw. traction unit.

efficient than a rotary and its transformers at full load, but the curve does not drop away so quickly on lower loads, so that the motor-converter frequently has an advantage, even in this respect, on widely fluctuating loads.

A feature of the motor-converter which is of special interest when traction applications are under consideration, is that the number of d.c. poles is just half that required on a

rotary-converter of the same size and speed. The brush spacing is therefore increased, and the risks of a flash-over practically eliminated.

As was indicated above, the motor-converter is capable of running inverted, and when running in this manner has excellent inherent voltage regulation, even on inductive loads. Where a.c. voltage regulation is required, a synchronous booster is generally employed, unless the set is running in parallel with other synchronous apparatus, in which case the latter would supply the wattless currents required by the converters on inductive loads.

The peculiar economy of the motor-converter is most marked on 60-cycle systems. On 25-cycles the first cost on smaller sets is somewhat larger than that of a rotary, and the latter is therefore the better commercial proposition. For sets of 1,000 kw. and upwards, however, the motor-converter holds its own.

The machine actually consists of two separate frames and is usually built up with three bearings. On the smaller machines the middle bearing is sometimes omitted, and the housing extended between the a.c. and d.c. frames. In this case, the interconnecting leads from the rotor to the armature are carried direct and not through the shaft, as is of course the case when a central bearing is used. With these small sets, a common spider is used for supporting the stampings of both armature and rotor, while on larger machines the rotor only is carried on a spider, the d.c. stampings being assembled direct on the

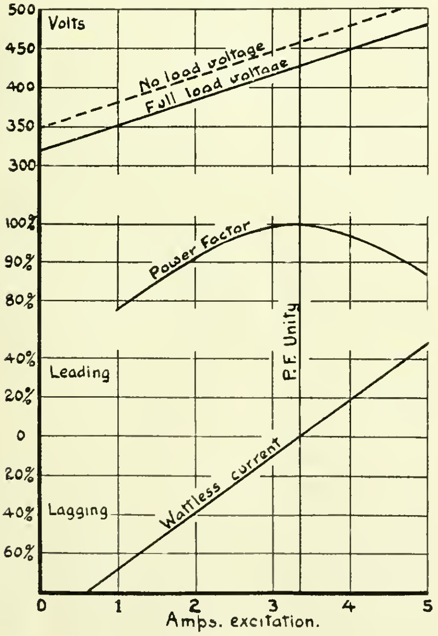


Fig. 4. - Regulation characteristics.

shaft. The slip-rings only carry current during the period of start, save in three-wire machines, where they have to carry the out-of-balance current. The standard short-circuiting gear which is used to form the star point of the rotor, is of a type which operates direct on the tappings themselves, thus cutting the slip rings out of circuit.

The d.c. field is usually fitted with commutating poles which materially assist the d.c. end to cope with large variations of current without alteration of the brush position. The air gap on the a.c. end is made very much larger than would be the case with an ordinary induction motor, as the primary power factor is not affected by this air gap. The insulation used in the stator is largely mica tubing which is formed under great pressure and heat and makes up into a surprisingly strong mechanical job. In fact these tubes can be machined exactly the same as could be done with fibre, and even better than would be the case when using "Micarta."

In these notes no attempt has been made to draw comparison between the various types of machine which may be used for converting from a.c. to d.c.; it is merely intended to explain the principles of a machine new to the Canadian electrical engineer.

The Automatic Flagman

The Automatic Flagman is a device to protect railway grade-crossings by giving effective warning of the approach of trains. In these days of rapid transit, something more than the old "Stop, Look and Listen" sign is necessary. Such signs are entirely too unobtrusive to attract the attention of the motorist going at 60 miles an hour and at night they are practically worthless. The "Automatic Flagman" however cannot be accused of being too modest. At the approach of a train it rings a loud gong and waves a bright red disc by day and a red lamp by night; so sensitive is the human eye to red and to motion, that such a warning can hardly escape notice. This device consists of a weather-proof case containing the operating mechanism and the signal disc upon which are mounted standard ruby-red switch lenses with an incandescent lamp between. Energy is supplied by a small Westinghouse electric motor which operates the mechanism that rings the gong and waves the disc. The motor receives its energy from storage batteries, lighting circuits, or trolley circuits, depending on the location and character of the installation. On steam roads, the track is insulated and bonded for the desired distance away from the signal and is charged with current from a small battery. The train on entering this block completes the circuit and operates a relay, which connects the motor with the power circuit. When the train leaves the block the circuit is opened and the motor disconnected.

On electric roads, the motor is connected to the trolley circuit by a contactor which is mounted on the trolley wire or third rail and is operated by the car as it passes. A second contactor disconnects the motor when the car passes the signal.

Further Plans for Montreal Underground

The Montreal Electrical Service Commission have applied to the Quebec Public Utilities Commission for sanction to plans for further underground conduits. The plans are, Craig to Notre Dame Streets, and McGill Street to St. Lawrence Boulevard, including Victoria Square, and one side of McGill Street from Notre Dame to William Streets; St. Lawrence Boulevard, from Commissioners Street to Sherbrooke Street; Commissioners Street to Notre Dame Street and McGill Street to St. Lawrence Boulevard; Atwater Avenue from St. Catherine Street to Western Avenue, and on Western Avenue to the city limits linking up with Westmount; also additions to Bleury Street, now under construction, for the fire alarm department and the Montreal, Light, Heat & Power Company. This company, the Tramways Company, and the Montreal Public Service Corporation objected to any further plans being passed on the ground that they could not deal with additional conduit work this year, and the Commission adjourned the application until June 2.

Electricity in the Modern Laundry

A splendid example of the modern electrically driven steam laundry is the New Method Laundry of Toronto.

The laundry proper is of brick construction 150 ft. x 50 ft. with a 10 ft. basement and two 15-foot storeys. Adjacent to the laundry are the stables, garage, repair shops, etc., housed in a two-storey brick building 150 ft. x 30 ft. The two buildings are separated by a 25 ft. wide cement drive roofed over, this latter is used as a shiping yard and is where the delivery waggons are housed for the night.

All machines are electrically driven and in most cases by individual motors. Though most of the ironing is done by steam heat, the smaller apparatus is supplied with electric elements. The equipment follows in detail.

Boiler Room Equipment

Power is supplied by the company's own private plant situated in the basement of the building. The boilers are two Canada Foundry units 150 h.p. each, of the horizontal tubular type. These are hand fed with an average of five tons of coal per day. The coal used is half and half of ¾-in. lump soft coal and hard coal screenings. Live fires are kept up all day maintaining a pressure of 125 lbs. At six o'clock in the evening the fires are banked until after midnight, when the fires are thoroughly cleaned, and at which time the pressure has dropped to about 50 lbs. The fires are then brightened up so as to have full pressure by six o'clock in the morning when the high pressure heating system is turned on. The boilers are equipped with forced draft obtained from a 60-in. Sturtevant fan direct-connected to a small steam engine. This fan supplies an air pressure of 2½ ounces per square inch.

Engine Room Equipment

The engine room equipment consists of two Robb engines 13-in. x 14-in. cylinders with a minimum each of 125 h.p. and a maximum of 160 h.p. These are direct connected to two 75 kw. Crocker-Wheeler Company generators, 125 volts d.c. 600 amperes, 275 r.p.m. These engine-generators are simply duplicate sets, one being held in reserve for emergencies. There is also a small 6 in. x 6 in. auxiliary vertical engine, direct-connected to one 11 kw., 125 volt, Crocker-Wheeler generator. This small generator is used for night lighting, for a large illuminated sign, for elevators, and for ash hoist. The small engine runs from six o'clock in the evening through until morning, utilizing what would otherwise have been waste steam at the end of a day's work, when the fires are banked.

Wiring and Lighting

The wiring distribution throughout the building is a two-wire system in conduit, the switchboard in the engine room being equipped with the usual complement of voltmeter and ammeters. The average day load is 550 amperes at 125 volts rising to 600 amperes during the winter months when the afternoon lighting comes on.

The lighting of the building is of a general character accomplished by 40, 60, and 150 watt tungstens, with enamel steel reflectors and amounts in all to 10 kw. The only special lighting is in the sorting room of the starched goods department where an illumination of approximately six foot-candles is used so as to insure against mistakes in making up the outgoing bundles from the lists.

Steam for Heating and Drying

Steam for heating and drying purposes is brought out from the boilers to a header and reduced to 90 lbs. for high pressure distribution. Separate risers carry this 90 lbs. steam to the various floors, machines and drying rooms. The returns from the high pessure heating come down in eight branches to a receiver. The condensation is taken from the receiver and returned into the boiler through a Moorehead trap.

Low pressure steam for general heating of the building in winter is taken off the header through a separate feeder with a reducing valve which reduces the pressure to 12 lbs. This low pressure heating takes care of the main building and the adjacent stables and residence.

Repair Shop

The engine room is also equipped with a repair shop containing a lathe, drill, and emery wheels where all repairs to machinery and electric equipment is done. This equipment is driven by a 2 h.p. motor.

General Layout of the Laundry

The laundry proper is divided into two general departments: one for household articles, such as table and bed linen known as flats, and the other for wearing apparel, both starched and unstarched. The flats are taken care of on the first floor. The starched goods are laundered on the second floor. The general layout and equipment of both departments are the same, but there are special features that can best be brought out by following through the routine in each.

Flat Work Department

The packages are brought in by each driver and placed in one of his own bins. Each driver has two bins, one for the Monday collections, and a second one, above the other, for the Tuesday collections. The idea is that no package brought in on Monday and not cleaned out of the bin during that day will become buried under the Tuesday bundles, and not receive preference over the Tuesday collections. The bundles are taken from the bins, opened up, and each article properly marked with the customer's designating number

The clothes first pass to the wash room which has the following equipment: five 100 in. x 40 in. wheels (washers); one 80 in. x 40 in.; two 60 in. x 40 in.; one 40 in. x 40 in. The time the clothes are in the wheels is approximately 75 minutes. From the wheels the clothes are taken to six extractors: one 40-in.; one 36-in.; four 30-in; and then part through two wet tumblers, 40-in. x 48-in. and part through one No. 3 dry-room tumbler, through which air is driven which has been heated by steam coils, 800 ft. of 1¼-in. pipe. Bath towels, bath mats, blankets, etc., are put through the dry room tumbler and receive no further ironing.

All these machines are driven from two line shafts, by one 20 h.p. and one 30 h.p. motor. The 40-in. extractor however is direct connected to a 5 h.p. motor.

The flat ironing room equipment consists of one 120-in. flatwork ironer driven by a 3 h.p. variable speed motor having a 40 per cent. speed variation; one 120-in. No. 4 compound flat-work ironer, driven by a 3 h.p. variable speed motor having 40 per cent. speed variation and one 120-in. 4-roller flat-work ironer for table linen driven by a 2 h.p. variable speed motor with 10 per cent. variation. A special point in the table linen mangle is the fact that it simply irons the linen on one side, thus bringing out the pattern in the weave of the cloth.

From the ironers the pieces are taken to the sorting room which has rows of large pigeon holes into which the clothes are sorted, checked up on the original lists which were brought in by the driver, then taken to the wrapping room where they are finally inspected before wrapping up for delivery.

The goods when wrapped are placed on a motor-driven canvas belt conveyor which carries the packages down to

the shipping room where they are sorted out into the bins of the various drivers.

Starched Goods and Flannels

This department is situated on the second floor of the building. The packages as in the case of the flat work are brought in by the drivers to one of their two bins, from which the clothes pass through the marking room, as before, and from there to the wash room.

The equipment of the wash room consists of one 60-in. x 36-in. wheels (washers); two 50-in. x 40-in.; two 48-in. x 40-in.; four 40-in. x 40-in.; two 30-in. x 30-in. Some of these wheels have both cylinder and casing of wood, used for all white goods, and the others wooden wheels with metal casing for flannels and colored goods. The two 30 x 30-in. wheels are for shorts or for goods which show spots after the first washing and are returned for further washing. The goods stay in these wheels approximately 75 minutes. The wringing of the clothes is accomplished by four 30-in. extractors, and one 24-in. extractor which takes about 15 minutes.

All of the above wheels and extractors are driven from two line shafts by two 10 h.p. motors.

One 50 x 36-inch collar tumbler, driven by a motor one-half horsepower, loosens up the mass of collars that come through the washing wheels and separates them for starching.

There are also six 30 x 30-in. porcelain tubes for the hand washing of silk materials, and delicate fabrics.

Starch Department

Three starch boilers of 20-gallon capacity each make up starch of different consistency for shirts, collars and fancy goods respectively. There are three 30-in. x 30-in. porcelain starch tubes for hand dipping. Collars are taken care of by one Bishop collar starcher driven by 1-10 h.p. motor. All dipped starched fancy goods are passed through the beforementioned 24-in extractor for removing surplus starch. There are two cuff and neck band starchers, driven by a 1/8 h.p. motor each, and two bosom starchers. There are also three rubbing down boards, steam heated, on which all wrinkles are rubbed out of shirt bosoms. All the machine starchers are equipped with steam chests supplied with high pressure steam for keeping the starch hot.

Dry Room Equipment

The flannel dry room is 10 x 10 x 8-ft., the temperature is maintained at 60 deg. by means of 675 feet of 1-in. piping arranged around three sides of the room. At the top of the room is a fan driven by a 1-5 h.p. motor for producing air circulation. Flannels remain in this room approximately 20 minutes. All socks and stockings are dried on wire frames which have an adjustable heel. This method of drying is not necessarily to prevent shrinking but to preserve the shape of the stocking.

The fancy work dry room is 10 x 10 x 8-ft., the temperature of which is maintained at 258 deg. by means of 850 feet of 1in. piping installed around three sides of the room as a steam coil. The wash pieces are carried suspended from an endless chain conveyor, having 5 loops inside of the dry room with a double length of approximately 100 feet of travel. It takes 19 minutes for a garment to pass through a dry room. The clips which fasten a garment to the travelling chain are automatically opened as they pass out of the dry room allowing the garment to drop into waiting baskets. There are two of these hooks every six inches on the chain.

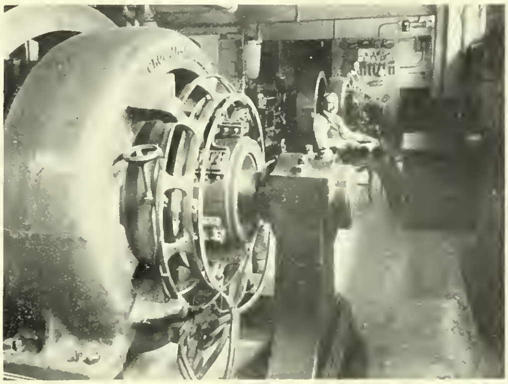
The collar dry room is 10 x 10 x 8-ft., steam heated to a temperature of 258 deg. by means of 750 feet of 1-in. piping in coils and equipped with a 5-loop travelling chain driven at a speed which will keep a collar in the dry room for 30 minutes. These collars also drop off automatically as they emerge from the room, on to a table.

The shirt dry room is 10 x 20 x 8-ft. with a partition in the center and is maintained at 258 deg. by means of 1,007 feet of 1-in. piping arranged in coils around three sides and on the partition. This room is equipped with a travelling carrier of 10 loops, the fifth loop coming out of the dry room to enable the shirts to air. The speed of the traveller is such that the shirts take 19 minutes to travel the full distance.

The fancy work, collars and shirt dry rooms are ventilated by means of overhead fans, which, together with the travelling carriers are driven by two 1 h.p. motors.

Curtain Dry Room

This room consists of what might be described as a large box opened at the top, 14 x 14 x 8-ft. and with a platform around the upper part. At the top of this box room on the inside is swung horizontally a large cylinder one-third of which completely fills up the opening in the top of the room. The cylinder is covered with felt and an outer covering of ruled canvas. Curtains are stretched on this cylinder frame, the rulings on the canvas enabling the curtains to be kept straight. The curtains are held down by long pins and in case of scollops each scollop is pinned. As soon as a curtain has been stretched the cylinder is given a one-third revolution turning the curtain side down into the dry room and presenting a fresh side of the cylinder at the top. Another curtain is now placed as before, and then turned down presenting the third section of the cylinder for the placing of another curtain. By the time this third curtain has been placed and the cylinder turned the first curtain which then appears is thoroughly dried. The temperature of this curtain drier is maintained at 200 deg. by means of 300 feet of 1¼-in. piping arranged in coils near the floor of the room, and in planes normal to the cylinder.



View of generator room—New Method Laundry.

Ironing Department

Shirts—The shirts are brought from the dry room, dampened by a shirt dampener, motor-driven by a 2-5 h.p. motor and passed to four cuff presses and four neck band and yoke presses which are foot operated and steam heated. Thence to four double bosom presses, shaft driven by a ¾ h.p. motor and all steam heated. These bosom presses have two bosom boards so arranged that one can be swung out to receive a shirt while the first one is under the press. The shirts now pass to four body ironers and to four sleeve ironers all shaft driven by two 1 h.p. motors. The body ironers are equipped with 4 kw. electric elements and the sleeve ironers with heating elements taking approximately 1 1 3 kw. The shirts are now ready for the hand finishers of which there are five using 600 watt 4 lb. electric hand irons. The finishers iron

out any stray wrinkles, fold the shirts and pass them on to the inspection table where they are inspected and an inspection slip put with each shirt. Each shirt is placed on a sheet of cardboard which has a sheet of tissue paper fastened to one edge of it, this paper is wrapped around the shirt protecting it from soil. The next move is to the sorting room where the shirt awaits the other pieces which came with it.

Collars—All collars are dampened in a machine dampener driven by a 1-5 h.p. motor, and then run through a 60-in. steam collar-ironer (1 h.p. motor). All collars pass to the collar table and are then shaped and have their edges and ends ironed by gas heated Art-edgers and end-ironers. Turnover collars are run through a seam dampener so that they can be bent without breaking the fabric, then moulded in a steam heated collar moulder and the top edge of collar ironed with an electrically-heated 600 watt shaper. Collars with turned-back tips have their tips steamed in a tip moistener and are pressed in a steam-heated tip bender, the two tips being ironed at the same time. All machines on the collar table are shaft driven by a 1 h.p. motor. All collars are inspected and damp bubbles or wrinkles are taken out on a foot power, steam-heated collar press. Down through the inspection table passes an enamel-lined steam coil jacketed tube 4-in. in diameter and about 24-in. long. As each collar passes inspection it is rolled up and placed in this tube and is forced down through into a waiting basket by the succeeding collars. The collars are in this tube for about two minutes and are thoroughly dried. From the collar table the collars are taken to the sorting room and each lot put in a narrow band of cardboard for delivery.

Flannels—Flannels after leaving the dry room are placed on a steaming table and carded with a whisk broom. There are 10 ironers, using 600 watt, 6 lb. and 750 watt, 8 lb. electric hand irons, on common ironing.

Fancy Work—Fancy work such as ladies' waists and underwear are all hand ironed by 11 electric 750 watt 8 lb. hand irons. There is also a steam-heated fluting iron and steam-heated balls of various shapes to press the shoulder and elbow puffs of ladies' waists.

The ironing boards for flannel and fancy ironing are placed in two rows and between them runs an endless conveyor chain with clips to which each operator attaches a garment as soon as finished. This conveyor passes down to the inspection table where all articles are inspected, mended (¼ h.p. sewing machine being used) and passed to the sorting room where each order is collected and wrapped together with the accompanying shirts and collars.

The bundles, each with its original list, are carried to the ground floor on a canvas belt conveyor to the shipping room where they are sorted into the various outgoing bins for the various drivers.

The equipment is so laid out on the two floors that the goods never retrace their steps. They pass continually forward from the washing wheels to the sorting room. Where it is not possible for one department to actually hand the goods over to the next there are mechanical conveyors or messenger girls so that no operator has to leave her machine.

Water and Soap—In a pent house above the top floor are located the soap kettles, bleach vats and hot and cold water tanks. Four hundred pounds of chipped soap are melted down twice a week making a total of 6,000 gallons of liquid soap per week. This soap is liquified and neutralized in a rectangular tank of 600 cubic feet capacity. One end of this tank is partitioned off for a reserve supply of soap which is used while a new batch is being made. The soap is piped down to the two wash rooms. The main water tank receives water from the city mains and filters it through a sand and canvas filter. The hot water tank contains 5,000 gallons and is heated by means of Hoppes feed water heater utilizing the exhaust steam of the engine. This hot water tank also contains a filter composed of coke, excelsior and canvas and is equipped with a motor-driven centrifugal circulating pump which circulates the hot water through the heater and filter bringing the water up to about 160 deg. F. There are 1,250,000 gallons of water used per month.

The 19 delivery wagons collect the work on Monday and Tuesday. Each driver received a bundle of lists covering his route, these are delivered to him in the order in which he will call for his work and each list has the customer's name, address, mark, and route number marked (addressograph) on it. As he goes to each customer he places the proper list in each bundle he receives. Customers are requested to separate flat work from starched work and the driver will find each week proper lists for each customer in his package of lists. The drivers in the outlying districts are met during the day by the motor truck at stated points and relieved of their load.

Appreciation is made for the courtesies extended by Mr. J. J. Sheedy, general manager, and Mr. H. W. Smith, engineer in charge.

Summary of Equipment With Uses

2	150 h.p.	Boilers	Horizontal tubular, 125 lbs. pressure
1	60 h.p.	Fan (draught)	4½ oz. air pressure per sq. in.
1	15 h.p.	Engine	Fan
1	4 h.p.	Motor	Ash hoist
2	160 h.p.	Engines	13-in. x 14-in., 275 r.p.m.
1	15 h.p.	Engine	6-in. x 6-in. 550 r.p.m., vertical
2	75 kw.	Generators	d.c., 125 v., 600 a., 275 r.p.m.
1	11 kw.	Generator	d.c., 125 v., 90 a., 550 r.p.m.
1	10 h.p.	Motor	Passenger & freight elevator
1	2 h.p.	Motor	Machine repair shop
1	2/5 h.p.	Motor	Tagging and sewing machines (on shaft)
1	20 h.p.	Motor	Driving shaft for flat work machines
1	30 h.p.	Motor	Driving shaft for flat work machines
1	5 h.p.	Motor	Hydro-extractor
1	3 h.p.	Motor	Cylinder calender
1	3 h.p.	Motor	Compound ironer
1	2 h.p.	Motor	Ironer
2	10 h.p.	Motors	Shafts for washers and extractors
1	½ h.p.	Motor	Collar tumbler.
1	1/10 h.p.	Motor	Collar starcher
2	1/8 h.p.	Motors	Cuff and neck band starchers
1	1/5 h.p.	Motor	Circulating fan in dry room
2	1 h.p.	Motors	Conveyors for dry rooms
1	1/5 h.p.	Motor	Collar dampener
1	2/5 h.p.	Motor	Shirt dampener
1	¾ h.p.	Motor	Double bosom press
2	1 h.p.	Motors	Body and sleeve ironers
1	2 h.p.	Motor	Mangle
1	1 h.p.	Motor	Collar mangle
4	1 1/3 kw.	Irons	Sleeves
4	4 kw.	Irons	Body Ironers
5	600 w.	Irons	4 lb.
21	600 & 750 w.	Irons	6 lb. and 8 lb.
1	2/5 h.p.	Motor	Chain Conveyor
1	600 w.	Iron	Collar shaper
1	1 h.p.	Motor	Shaft driving machines on collar table
1	1/4 h.p.	Motor	Sewing machines
1	1 h.p.	Motor	Belt conveyor
1	5 h.p.	Motor	Circulating pump
1	5 h.p.	Motor	Grinding feed.

Electric Railways

Increase in B. C. E. R. Rates Sustained

The adoption by the Vancouver board of trade of the majority report of the special committee appointed to investigate street car fares as levied by the British Columbia Electric Railway Company, Limited, is a vindication of the company's action last September in proclaiming a straight five cent rate. Considerable interest has been caused throughout Canada by the investigation and the result has been awaited with much interest by the various electrical transportation concerns which may contemplate a similar policy in regard to street car fares. Following is the complete majority report:

Mr. President, and members of the board of trade,—Gentlemen:—Your committee appointed to investigate the matter of the recent increase in fares by the B. C. Electric Railway Company in the city of Vancouver in September last, herewith beg to set out its report:

We feel that any findings this board makes should be based on a fair analysis of conditions, as to the cost of labor, cost of material, and any other exigencies which enter into the development, equipment and maintenance of a passenger carrying system, such as that provided by the B. C. Electric Railway Company.

Your committee has held ten meetings and has obtained information with respect to the cost of fares and areas served by such fares, from Montreal, Toronto, Winnipeg, Edmonton, Calgary, Seattle, Portland, San Francisco and Los Angeles. We have also obtained a great deal of information from officers of the B. C. Electric Railway Company, who have invariably treated the committee with courtesy.

Our finding is that the B. C. Electric Railway Company was, under existing conditions, justified in raising its fares, but that as soon as the present high proportion of expense to earnings can be reduced, a reconsideration of the fares charged will be justifiable. We submit the following as some of the reasons for our finding:

The money actually expended up to June 30, 1913, amounted to $45,168,312, and the amount paid out in interest and dividends for the year amounted to $1,888,139, equal to 4.18 per cent. on the entire investment.

That during the last ten years the cost of equipment, supplies and wages has increased at least 25 per cent. The wages paid by the B. C. Electric Railway Company are about 10 per cent. higher than those paid in any other Pacific coast city, and from 20 to 25 per cent. higher than those paid in the cities of Eastern Canada.

Conductors and motormen on the company's system receive 27 cents per hour for the first year, increasing to 36½ cents per hour in the fifth year, while Seattle pays 25 cents per hour the first year, increasing to 32 cents in fifteen years; Portland pays 25 cents per hour for first year, increasing to 31 cents per hour in the sixth year; San Francisco pays 25 cents per hour the first year, increasing to 33 cents per hour in the ninth year; Los Angeles pays 25 cents per hour the first year, increasing to 30 cents in five years; Montreal pays 23 cents per hour the first year, increasing to 25 cents per hour the third year and thereafter; Toronto pays 23½ cents per hour the first year, increasing to 27½ cents the third year and thereafter; Winnipeg pays 25 cents per hour the first year, increasing to 34 cents in the fourth year.

A similar comparison of the wages paid to trackmen, barnmen and mechanics, shows a corresponding increase paid by the B. C. Electric Railway Company as compared with the above mentioned cities.

There are about 800 conductors and motormen employed in Vancouver and on the suburban lines, working an average of nine hours per day. These men receive 18 cents more per day than paid in any other coast city. This amounts to $52,560 in a year, and if we include the trackmen, barnmen and mechanics the amount would be more than doubled. Again, equipment and supplies are about 15 per cent. higher in Vancouver than in other coast cities, and 10 per cent. higher than in Eastern Canadian cities.

For example, a car costing $7,407.80 at Vancouver can be purchased in Seattle for $5,986.40, and in Toronto for $6,522.25. With respect to operating expenses the Electric Railway Journal of October 25, 1913, shows the operating expense ratios of forty of the leading electric railway systems of this continent. The average is 59.09 per cent., and the B. C. Electric Railway Company has the highest ratio, amounting to 75.03 per cent. The figures given relate only to straight operating expenses and do not include any charge for renewals, depreciation, taxes or accident reserve.

It has been put forward in a criticism of the B. C. Electric Railway Company that other companies serve a greater area for the same fare than that railway, but we have considered that the area served by any railway is no indication of the service rendered to the public without taking into consideration the population, track mileage, and number of cars operated within that area. The North Vancouver service with nearly ten miles of trackage and a population of about 8,000 covers an area almost as large as the city of Vancouver with a population of 120,000 people, and seventy miles of trackage.

Another argument has been advanced in some quarters that owing to the policy of the company of contesting so many accident claims in court the expenses in connection with this department have been excessive. This statement has not been borne out by the facts as the following figures will show: The total number of accident cases dealt with by the B. C. Electric Railway Company from January 1, 1911, to February 20, 1914, was 1,420. Of these 66 were contested in court and 1,354 amicably settled without reference to law. This shows an average contested of less than 5 per cent.

We asked the company to state to the committee the cost of power charged them and were informed that they could not answer specifically as to the charge per horse-power or kw. hour, but submitted the following table showing the cost per car mile for the year ending June 30, 1913, as compared with the cost on other systems in Canada:

Cost of power per car-mile.	Cents
B. C. Electric Railway	2.98

Montreal	2.62
Toronto	2.58
Winnipeg	2.81
Edmonton	11.22
Calgary	5.23

The revenue per car mile for four of the leading electric railway systems of Canada in 1912 shows Vancouver the least remunerative in that regard. Toronto provided $42,846 per car mile; Montreal $30,259; Winnipeg $23,230, and Vancouver $22,038.

We find further that with few exceptions the usual fare charged in the principal cities of the United States is 5 cents. In Canada the fare is usually about the same as that charged by the B. C. Electric Railway Company previous to September last. The straight 5-cent fare is charged in nearly all the Pacific coast cities, including Seattle, San Francisco and Los Angeles. In Portland the fare is 5 cents or 50 tickets for $2.25.

To the best of our knowledge the B. C. Electric Railway Company is the only company on the Pacific coast selling workingmen's tickets at 4 cents. These are issued in ten tickets for 40 cents, five white and five green, the white tickets being good from 5 a.m. to 8 a.m. and the green are good at all hours.

A good deal has been said about the distance that passengers are carried in other cities for one fare as compared with Vancouver. We think there is not much to complain of in this respect, as city passengers can travel from Alma road and Tenth avenue to Hastings street and Boundary avenue, a distance of 8.35 miles, and settlers are carried from Dunbar street and Wilson road to Hastings street and Boundary avenue, a distance of 11.78 miles for 5 cents.

Notwithstanding the fact that the number of passengers carried has been steadily falling off from June last, the company is giving better service than ever, the number of car miles at present averaging about 90,000 per year more than in 1912.

The growth of traffic in years previous to 1913 warranted liberal outlays in development and equipment, and consequent on these outlays the operating expenses increased very considerably. In 1908 the rate of operating expenses of the railway department, exclusive of interest on outlay, was 71.09 per cent. of gross earnings; this ratio increased to 91 per cent. in 1913. In 1913 the gross earnings were three and one-half times as much as in 1908, but the net earnings were the same as in 1908, notwithstanding the fact as stated by the company that three times the amount of capital was employed in 1913 as compared with 1908.

The total capital invested by the company has increased by about $6,000,000 annually for the last five years, and now totals about $45,000,000. Your committee has taken into consideration that the securing of capital for such undertakings as this is naturally dependent upon a fair return on the investment.

The conditions which we find justify the increase in fares, call for and have resulted in strict economy in expenses and management, and it may be reasonably expected that in time these economies will reduce the present high proportion of operating expenses sufficiently to warrant a reconsideration of fares charged, but such reductions cannot be expected to greatly influence return on invested capital until passenger traffic increases.

Hull Fares Upheld

The application of Mayor Baillie, of Aylmer, made to the Railway Commission, on behalf of the town of Aylmer on Tuesday, May 19th, for a reduction of the fare between the city of Hull and Aylmer on the Hull Electric Railway, was dismissed by the Board after each side had been heard briefly. Mayor Baillie told the board that there are 400 people in Aylmer who work in Ottawa all the year round and that the number would be increased if the fares on the Hull Electric were reduced. Mr. E. W. Beatty, representing the company submitted facts and figures showing that the fares per mile on the Hull Electric are lower than on many other similar roads in Canada and the United States; he also explained that the company only pays a dividend of 3.7 per cent. Mr. Gordon Gale, general manager for the company, stated that one car with about 50 government employees came into Ottawa every day, and he took issue with Mayor Baillie's statement that 400 people travelled daily into the capital from Aylmer.

Chairman Drayton decided that as the company's earnings were comparatively small the application would have to be dismissed.

Solid and Insert Manganese Special Track Work

In the city of Chicago during the last eight years exhaustive tests under the direction of the Board of Supervising Engineers have been carried out on solid and insert manganese steel as applied to track work. The current issue of the Electric Railway Journal prints the history and results of this work, the latter of which are of extreme value. We print extracts of the report below.

In probably no other city has manganese steel special work received more thorough and exhaustive test than on the surface lines of Chicago. Experience with the three types of special work, namely, solid manganese, cast-iron bound manganese insert, and cast-steel manganese insert, began in 1908. Since that time more than 1,000 installations including more than 10,000 pieces, have been laid down. This large number of installations, as well as the wide divergence in the character of traffic, namely, from a density of a few seconds' headway in the downtown district to several minutes' headway as found on outlying cross-town lines, makes this test exhaustive in scope and convincing in results. Moreover, installations were furnished by practically all of the large manganese track special work manufacturers in this country; consequently it should be representative of what may be expected of various designs of this material as installed in Chicago. Experience there under all classes of traffic has demonstrated clearly the advantages and disadvantages of the different types in a much shorter time than could be possible in any other city where the traffic is lighter.

It may be well first to consider the conditions under which this manganese special work was purchased. In 1907 and 1908 ordinances were passed granting franchises to the four surface railways operating within the corporate limits of Chicago. Among other things they provided for a comprehensive reconstruction of all the tracks inside the city. This work was done under the direction of the Board of Supervising Engineers. In the board's endeavor to make the rehabilitated work as permanent as possible, it thoroughly investigated many of the different types of track construction and track materials in general use at that time and consulted with the manufacturers. Specifications under which the manufacturers were willing to bid with a three-year guarantee were then adopted. The specifications issued at that time for the manufacture of track special work were the first general specifications for that kind of material to be prepared by anyone.

The clauses in the ordinances which referred to special work merely required that at all track intersections suitable steel special work of ample strength and weight, to correspond with the structure to which it connected, should be provided and that frogs, switches and mates should be furnished with wearing plates of hardened steel. Investigation by the

board developed the fact that special work manufactured of hardened steel or manganese steel designed to withstand extraordinary wear could be purchased with a three-year guarantee. This made it desirable from an economy standpoint, and at that time it was believed that solid manganese would give a maximum wearing life at the minimum cost of operation. It should be noted, however, that the guarantee clause was eliminated from the specifications about February, 1910.

Special Work Specifications

The specifications governing the manufacture of track special work were made to cover four types, namely, A, B, C and D, and each type was specified in 7-in. and 9-in. rail depths. Type A was made with a solid-steel casting for running rails, with manganese steel plates inserted at the wear points. Type B was made of solid manganese castings, arranged to fish with abutting rails. Type C was a cast-steel bound or cast-iron bound construction, using standard Chicago rail with manganese steel plates inserted at the points of greatest wear. Type D was ordinary built-up track special work composed of rolled Chicago rail sections and mechanical joints. Other portions of these specifications provided for over-all dimensions, tolerances, drilling and inspection.

All special work was built to a gauge of 4 ft. 8½ in. on straight track and on curves having a radius greater than 80 ft. On curves sharper than an 80-ft. radius, the gauge was increased ¼ in. In all special work, however, a maximum variation of ⅛ in. greater than standard gauge was allowed. All switches, mates and frogs were designed for 3½-in. wheel-tread clearance, a 1 3/16-in. throat and a tongue throw of 1¼ in. All exterior frog arms were required to be of sufficient length to permit easy access for placing the joint plates. In all cases it was required that the over-all length should not be greater than these specified dimensions or more than ⅛ in. less than the same. Ninety-degree crossing frogs were considered in a separate class, and the exterior arms were required to be of a length equal to one-half the distance between the gauge lines of the inside rails of parallel tracks, with an allowance of 1/16 in. for joints. The object of these limit dimensions in 90-deg. crossings was to make them interchangeable.

At the time the special work specifications were adopted there was considerable discussion among the members of the board as to the proper depth of groove. It was agreed that the shallow groove would tend to reduce noise. After a discussion of the various types, it was finally decided that all points involved could best be served by making the groove depth 11/16 in. It was thought that this depth would provide entire safety for the passage of cars and at the same time reduce noise, or at least that it would determine the effect of depth of groove upon the elimination of noise at crossings. This was in 1909, and since that time the 11/16-in. depth has remained the standard.

Some time during 1906 the 129-lb. Chicago girder-grooved rail section was adopted. The specifications for the manufacture of this rail were drawn in such a way as to provide rails that would give a maximum wearing life under heavy street railway service.

The specification did not call for any particular chemical composition in the manganese steel used in the solid and insert track special work, it being left to the manufacturers to furnish material that would meet the three-year guarantee. In 1909, however, after considerable solid manganese work had been installed, it was thought desirable to obtain information as to the character of manganese steel placed in the track special work. Accordingly, a number of switch tongues were purchased from the manufacturers supplying the special work for Chicago, and these pieces were tested for physical characteristics by a firm of inspecting engineers.

The tests to which the manganese switch points were subjected were of three kinds, namely, drill tests, ball impression tests and transverse bending tests. In the first tests, the drill was used for a period of two minutes, then resharpened, and the operation repeated four times. It was found that all of the samples were practically undrillable. The depth of the holes, after the completion of the tests, were measured to the nearest 0.001 in., and the average for the three was 0.0327 in.

In the ball impression test a steel ball 7/16 in. in diameter was set on the faces of the three tongue-switch specimens and subjected to a load of 35,000 lb. Upon removal the diameter of the impression in the surface of the manganese tongue was measured, and in each case it was found to be 0.32 in. This indicated that the surface hardness averaged approximately the same in the three sample switch tongues tested.

In the transverse bending tests of manganese tongue switches, great care was exercised in applying the load to the three samples so that the test conditions for each might be the same. Each tongue was laid on supports exactly 3 ft apart, and the load was applied at the lug, the tongue resting on these supports in an inverted position. In each case it was found that the elastic limit was reached when the load was approximately 14,000 lb.

Chemical Analysis of Three Manganese Tongues, Chicago

	"A" per cent.	"B" per cent.	"C" per cent.
Carbon (combustion)	1.100	1.260	1.240
Carbon (color)	1.010	1.150	1.190
Silicon	0.470	0.260	0.350
Manganese	11.440	10.880	12.480
Manganese (check)	11.280	10.960	12.560
Phosphorous	0.067	0.056	0.084
Sulphur	0.021	0.036	0.033
Copper	None	0.340	0.090

In addition to the physical tests a chemical analysis was made of three sample tongues by two representative analytical chemists. While there was some variation in the results of the chemical analyses made by the two chemists, the relative proportions of the constituent elements in the three samples were approximately the same.

As an additional precaution in the board's endeavor to secure special work pieces equal to the specification and containing no mechanical defects, all work was inspected at the point of manufacture. Besides the inspection for correct dimensions, evidences of cold shot, fractures or segregation of the metal in the head or wearing part of any special-work casting were considered sufficient cause for rejection. Other fractures or cracks appearing in the base of the casting which, in the judgment of the inspector, did not extend into the web or strain a bearing part of the casting, sufficiently to impair its usefulness, were not considered causes for rejection.

Cracks were permitted in the web of the rail at the end, provided they did not extend beyond the first bolt hole in either the upper or lower row. Cracks in the end of the web of the rail which did not terminate in the bolt holes were considered sufficient cause to reject a piece, provided these cracks extended more than 1½ in. in from the end of the rail. Fractures or cracks in switch pieces near the box which did not affect the strength of the switch piece, in the judgment of the inspector, did not cause rejection of the piece.

In practically all cases the method of installing track special work in Chicago has been the same. This includes an 8-in. crushed-stone ballast foundation, 7-in. x 9-in. white oak ties on 2-ft. centers, cut to special lengths to fit each

crossing. In most instances it was impossible to roll the crushed-stone foundation under these crossings because intersecting traffic could not be interrupted. This made it necessary to leave out the paving for a certain period so that the crossing could be retamped repeatedly until a thoroughly compact bearing was secured. The character of foundation has not been the cause of crossing failures except in a very few instances. In fact, the failures at points where the foundation has given way are no worse than those where the foundation has stood up. All complicated crossings were purchased built of several pieces so that renewals could be made by replacing only the failed or worn-out portions. Simple right-angle intersections as a rule were purchased in a solid piece for each track crossing. In order to allow for expansion and contraction as well as to preserve the temper of solid manganese special work, all connections were made with mechanical joints.

Solid Manganese Steel Service Results

A most careful and impartial inspection of a great number of special-work installations shows all too plainly what effect traffic has had on the three types of special work used in Chicago. With the possible exception of switches and mates, it is said that more than 50 per cent. of the solid manganese pieces have failed before the end of the three-year guarantee. Those remaining were in excellent condition at the time of inspection and represent what was expected of the solid manganese when it was adopted for track special work.

Inspections beginning in 1908, soon after the first pieces were installed, and continued to date, show that the solid manganese began to fail by "chipping" at the wear-points soon after the first year. The number of points chipped, however, reached a maximum at the end of two and one-half years regardless of the density of traffic, and in many instances renewals were necessary to provide safe operation. The character of the chipping in most instances was much the same and indicated that the piece was improperly tempered, or that there was a segregation of the metal at the points of failure. In practically all cases, as might be expected, the first pieces were broken from the receiving rail corners. Usually the broken piece took the form of a triangular prism which feathered out in the ball of the running rails and was thickest at the point of intersecting flangeways. One explanation of the failure is that it was the termination of life due to the low elastic limit of the material. According to this explanation the comparatively small area receiving the blow from the narrow tread wheels is stretched and pulled beyond the elastic limit of the material, the great tenacity of the material preventing rupture until the material finally parts in prismatic portions as described. In this respect, the effect differs from chipping which occurs from too hard material with high elastic limit and ultimate strength not much larger than the elastic limit.

Another class of failure in the solid-manganese crossings took the form of cupping or cold rolling. As in the case of "chipping" no definite rule could be drawn, because pieces failed both ways, again indicating that the tempering process or the inherent qualities of the metal made it unsuitable to withstand repeated impact blows. The cupping or cold rolling usually followed the chipping, and in no case was it confined to the intersecting flangeways but was quite evident the full length of the manganese running rails. Some of the solid manganese right-angle crossings were bought in one piece and some in halves. At the present time the tendency among the manufacturers is not to supply the crossing in one piece, in the belief that this plan is not conducive to long life.

One of the most prominent evidences of cold rolling was found where dense traffic moves over one line and little or no traffic passes over the intersecting line. In many instances the metal has flowed until the intersecting flangeway is practically closed where it crosses the heavy traffic running rail. In other instances the effect of cold rolling is to flatten the ball of the manganese rail. This may be noted in the illustrations, where the tread-wear area on manganese rail is apparently much wider than on the standard Chicago rail. This effect was also quite marked at the points where the standard unbroken main-line frogs were installed in which the floor of the throatway is level with the unbroken main-line running rail. Where traffic was heavy on the main line, as much as ½-in. wear, resulting in this difference in the elevation of the top of the main-line running rail and the branch-off throatway-floor, was noted in several instances.

In connection with the cold rolling or cupping it may be of interest to note that in most instances the metal flows to both sides of the ball of the rail. That flowing to the flangeway side is sheared off by the wheel flanges, and that on the opposite side forms a lip over the lower portion of the ball similar to low-carbon steel rails under heavy traffic. It may also be of interest to state that the cupping does not appear to depend on the character of support. To substantiate this, the cupping at joints represents the supported form over a single web. That in acute angle flangeway intersections was where the points receiving greatest impact were suspended between two web supports. The 90-deg. crossings usually have one supported and one suspended point of impact. As a general rule it might be stated, however, that chipping predominates in the 90-deg. intersections and cupping at the acute-angle intersections.

Cupping at the manganese receiving rail is found invariably, but it is seldom at the run-off from the manganese to the Chicago rail. In angle crossings of switch pieces cupping in one manganese rail also reflects a cup in the opposite rail. Cupping takes place regardless of the condition of the joint, and in many instances it was found most prominent where there was no appreciable difference in the elevation of the two butting rails. In other cases where there was considerable offset and the receiving rail was the Chicago section, the cupping was slight.

The tests made on the sample switch tongues indicated that the best quality of manganese steel for track work was its ability to resist abrasion. In order to check this a number of points were inspected, and invariably the result was the same, namely, there was no appreciable difference between this quality of manganese steel and that of the Chicago rail. The slow movement of traffic around the curves caused the running rail to wear and show the effect of cold rolling to a far greater degree than the abrasive wear on the guard. For this reason it is believed that renewals will have to be made for running-rail wear rather than for guard-rail wear.

Service Results of Manganese Insert Special Work

A similar study of cast-steel and iron-bound renewable manganese insert special work under the various classes of traffic and for various life periods was made. While the inspections indicated that the manganese inserts failed by chipping there was little or no evidence of cold rolling. These inspections also indicated that the chipping of inserts began after the first year in most instances but was the worst after two and one-half years' service. Again this appears to be a problem in tempering, but the failures of inserts are fewer, and, on the other hand, many of the faulty inserts may be renewed without any disturbance to the pavement. In contrast with the solid manganese special work, however very little evidence of cold rolling or cupping was found in the cast steel or Chicago rail arms in the crossing frogs. In fact, many insert pieces were inspected which had been under more severe traffic conditions than the solid man-

ganese, yet the common forms of failure in the latter were not found.

Experience with renewable insert special work in Chicago demonstrates that it is possible to maintain some forms tight in the spelter bed. Although some of these renewable inserts have become loose, a few probably because they were improperly set and fastened by the manufacturers, others indicate that the manner of fastening was not of sufficient mechanical strength to withstand the severe impact blows. As a rule inspections tended to bring out the fact that most loose inserts occurred at the 90-deg. crossings and that at angles of less than 90 deg. intersection the loose inserts were seldom found. When these renewable insert pieces did not fail mechanically and were under very heavy traffic, the service results were far superior to solid manganese. This is shown in some of the illustrations. It was also found that, as a rule, cast-steel arms with manganese inserts stood up better under all classes of traffic than the cast-steel or cast-iron bound frogs. In the cast-steel arm type, however, the same problem arose at times as with manganese steel, namely, there was a lack of uniformity in the quality of the cast-steel furnished by the same or different manufacturers. The cupping and cold rolling are also held to be evidences of the quality of the material mentioned in the previous paragraph.

Manganese Switches and Mates

The Chicago standard switches and mates, generally speaking, have stood up better than the frogs and crossings, yet under heavy traffic cupping at the receiving end of the manganese piece, as well as at the heel of the tongue, was quite pronounced. Where traffic was heavy through the branch-off, the tongue indicates unusual wearing qualities. Where traffic was heavy along the straight track, cupping and cold rolling throughout the manganese piece was quite evident.

Repairing Manganese Steel With Electric Welder

Another point which may be of interest in connection with solid manganese is the experience accompanying attempts to repair it by electric welding. Tests have been made to build up broken points and cupped joints in solid manganese steel special work in some cases with satisfactory results, though in some others with failures. Here again the peculiar characteristics of the metal make difficult the process of repair with an electric welder. With manganese alloy in steel the usual tempering process has to be reversed, that is to say, gradual cooling makes a casting hard and brittle. Consequently as the piece comes from the mold it is hard and brittle and the heating or annealing process is followed by quenching which brings about the desired toughness. During the process of welding new metal onto broken points in manganese steel special work, a portion of the old manganese casting becomes heated to a welding temperature. This results in a hardening of a portion of the old casting, which in many cases becomes quite brittle, and new breaks occur. Undoubtedly the reason for the success of welds of this kind in those cases where it has proved successful is that the portion of the old casting heated was confined to a very small area. It may be possible to overcome this difficulty, but even under present conditions 50 per cent. of the castings thus repaired have stood up under service for a time, and as the cost of making the repair is small the use of the welding outfit seems worth while.

Typical Failures of Manganese Steel

An examination of the solid manganese failures under varying traffic conditions brought out the fact that cupping and cold rolling predominated. It may be stated generally that the Chicago rail laid on various types of foundations has developed little or no cupping up to the present time. There are a number of instances where rail corrugation has developed, but this may be attributed to causes other than that bringing about cupping at the rail joints. On the other hand, cupping and cold rolling were largely confined to the manganese steel special work and especially in the solid manganese. Almost invariably where the manganese steel piece was the receiving rail, cupping developed regardless of the density of traffic or the condition of the joint.

In order that accurate comparisons could be made of the various special work installations, it was necessary to reduce the traffic and tonnage over each point discussed to a unit basis. This was accomplished by computing the total number of cars in all directions, passing over a particular crossing in a twenty-four-hour week-day and a twenty-four-hour Sunday. From these the average number of cars per hour and then the average number of wheels were computed, four wheels being taken for each double-track car as the number passing over any given point. To arrive at the unit tonnage figure, it was estimated that the average double-truck car in Chicago weighed 50,000 lb. and that the average passenger load was 10,000 lb. This total, or 60,000 lb., was divided by eight for the unit load per wheel and was multiplied by the number of wheels passing over a given point per hour.

Canadian Electric Railway Association Convention

The Canadian Electric Railway Association held their annual convention at the Chateau Laurier, Ottawa, May 13 and 14. At the closing session Mr. C. B. King, manager of the London Street Railway, was elected president for the ensuing year. The other officers are: J. D. Fraser, vice-president; executive committee: E. P. Coleman, general manager Dominion Power and Transmission Company, Hamilton; A. Eastman, vice-president and general manager Windsor, Essex and Lake Shore Rapid Railway, Kingsville; H. M. Hopper, general manager St. John Street Railway; Wilson Phillips, superintendent Winnipeg Electric Railway; C. L. Wilson, assistant manager Toronto and York Radial Railway; Patrick Dubee, secretary-treasurer Montreal Tramways Company, retiring president, member of the executive committee ex-officio.

During the convention the following papers were read: Steel Car Construction, J. A. Wilson, Superintendent Car Department, Ottawa Car Manufacturing Company; The Diesel Crude Oil Engine as Applied to Street Railway Operation, A. H. Dion, Superintendent, Moose Jaw Street Railway; Prevention of Accidents, A. E. Beck, Claims Solicitor, British Columbia Electric Railway; Floral Work at Railway Stations, E. T. Cook, F.R.H.S., author of Gardens of England, etc.; Recent Improvements in Electric Car Equipment, W. G. Gordon, Transportation Engineer, Canadian General Electric Company; A Few Disconnected Ideas on Street Railway Operation, F. D. Burpee, Superintendent, Ottawa Electric Railway; Construction Accounting, E. P. Coleman, General Manager, Dominion Power and Transmission Company, Hamilton; Loyalty in Electric Railway Work, A. M. Smith, Master Mechanic, Toronto and York Radial Railway.

On the evening of Wednesday the 25th, the delegates were entertained at dinner at the Royal Ottawa Golf Club, by the Ottawa Electric Railway Company. At this function Mr. Thomas Ahearn, president of the company, presided, and Mr. Warren Y. Soper, vice-president of the O. E. R., entertained the company with some slight of hand tricks at which he is much better than a good many professionals. The Hull Electric Railway gave a luncheon the next day. The business discussed at the convention was private. It has not yet been decided where the next convention will be held.

Illumination

Globes and Reflectors for the New High Candle Power Mazda Lamps

It is difficult to classify all of the uses to which the new nitrogen lamps will be put, for they undoubtedly bring revolutionary changes wherever high candle-power units are required, and because of their simplicity will be instrumental in opening many new fields for the use of artificial light. They are particularly adapted to the lighting of large areas, especially where the units must of necesssity be hung high, as for example, such cases of industrial lighting where cranes, derricks, etc., make low suspension of the units either impractical or impossible. Stores, auditoriums, armories, railway concourses and hotel lobbies are representative of a large class of interiors in which these units can be used to advantage, with direct, semi-indirect or totally indirect fixtures, as the individual cases may require. In general where the ceilings are high, the direct system of lighting can be used with satisfactory results; where the ceilings are low, the semi-indirect or indirect systems are recommended. The lighting of such outdoor areas, as athletic fields, motor dromes, yards and amusement parks can be advantageously accomplished by the use of these large units.

It is evident to all who have studied these new units, that unusual care must be taken in selecting globes and reflectors that will give the maximum illumination on the desired plane, without the objectionable glare affecting the visual acuity of the eye.

The reflectors and diffusing units shown in the accompanying illustrations have been designed for use with high efficiency, 500 and 1,000 watt lamps.

Fig. 1 is designed for semi-indirect lighting of large interiors. This unit is supplied with a prismatic reflector, covered by a Druid stalactite. The indirect light given by the reflector produces an almost shadowless illumination without the large volume of direct light given by ordinary semi-indirect units.

The units shown in Figs. 2 and 3 are both designed for large interiors, being particularly suited for high class stores,

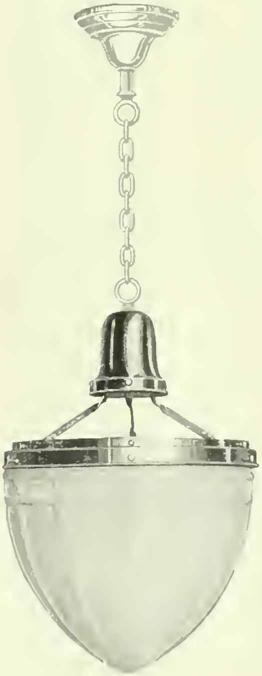


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

hotel lobbies, theatre foyers, armories and large auditoriums. The Pyro reflector and C. R. O. bottom make units of excellent appearance and good efficiency. Special ventilation in band and fitter provide against excessive heat and special supporting devices in the fixtures insure that there will be no strains to cause breakage.

Fig. 4 consists of a specially ventilated fixture with an opal glass ball having a ¾-in. hole in the bottom. The top is tapped for suspension from half inch pipe. This fixture is weatherproof and can be used outdoors. A small porcelain reflector is used inside the fixture to add to the efficiency of the unit. Another type called the "White Way" unit, is especially made for outside use,—street, theatre or store front lighting. It is similar to Fig. 4 but has a twenty-inch radial reflector.

Fig. 5 is a handsome street lighting unit. This new unit

Fig. 7

Fig. 8

with a Pyro top and C. R. O. bottom shows excellent efficiency, good diffusion, is low in cost and distributes the light in a manner almost ideal for street lighting. It is furnished complete with a fixture designed to separate the glass parts from one another for proper ventilation. There is a large field for the new mazda lamps in street lighting. Ornamental standards with multiple lamps permit the better spacing of units, provide more useful light, better distribution freedom from overhanging obstructions and greater beauty in effect.

For industrial, platform and outdoor lighting, where conditions for high mountings permit of open reflectors, the reflectors shown in Figs. 6 and 7 should find a considerable field. Fig. 8 shows the attachment which completes the unit for outdoor use. It consists of a ventilated enamel hood including mogul socket.

The types shown herewith are the product of the Holophane Section of the Canadian General Electric Company, Limited.

Illumination an Important Factor in the "Safety First" Movement

A paper was recently read by Mr. R. E. Simpson before the Illuminating Engineering Society, New York section, on the subject of "Illumination as a Safety Factor in Industrial Plants." In these days when such strenuous efforts are being put forth to preserve not only the life but the working capacity of the individual it is too often lost sight of that many of the accidents to workers engaged in industrial life of one kind or another are very often attributable directly to poor light. This is all the more deplorable since the means for providing excellent illumination are now obtainable at minimum expense. There is, however, an almost unaccountable indifference shown by the management of many of these plants to their system of illumination. Scientific data shows conclusively, however, both that the number of accidents is reduced and that the quantity and quality of the work is improved under corrected conditions. Mr. Simpson's paper gives some interesting statistics in connection with this matter extracts from which are reproduced herewith.

Of the 50,000 yearly avoidable accidents that occurred in the United States, possibly 25 per cent. are due directly or indirectly to inadequate illumination. Reports of the various state labor bureaus and by the federal government give the number of accidents classified under various heads, such as breaking of hoists, cranes, winches, etc.; bursting of grindstones, etc., contact with mill gearing, persons falling or being struck by falling tools or other objects; but rarely, if ever, is poor illumination among the causes, although many of the reports mentioned this as an indirect or contributory cause.

The evidence that poor illumination is the cause of accident is so hard to get, and so few statistics are kept as to this cause that very few employers consider that a large proportion of their accidents are due to the improper use of light.

For the purpose of showing the relation of illumination and accidents, two curves are shown herewith. One, Fig. 1, illustrates the relation of daylight to accidents and shows the number of persons fatally injured in a large group of plants covering a period of three consecutive years, grouping the accidents according to the months of the year. It will be seen from this that during July, August, September, March, April, May and June, the number of accidents per month for the entire three-year period remains practically constant at about 150. In other words, when the day was long enough to give good illumination throughout the working hours, the number of fatal accidents was fairly uniform. When the hours of darkness increased, however, the number of accidents increased also, so that in December and January it was no less than 40 per cent. greater than normal. That the connection between accidents and daylight is close is shown with remarkable clearness by comparing the "accident curve" with the curve showing the "hours of darkness" throughout the year. This curve, Fig. 2, shows the hours of darkness at the latitude of Hartford, Conn., for each calendar day of twenty-four hours, considering, for the sake of brevity, darkness to sig-

nify the period between sunset of one day and sunrise of the next day following. When the nights are short enough to insure a good light throughout the working day, a further shortening of the period of darkness would not diminish the number of day accidents, but would affect only night labor. Therefore, assuming a period of darkness less than twelve hours would have no effect on the day accidents, the straight horizontal lines A B and D E have been drawn at a height corresponding to a twelve-hour night. By comparing the heavy line darkness curve with the accident curve, a striking similarity is found.

Many instances of fatal accidents are at hand that have resulted to workmen in factories where only local illumination

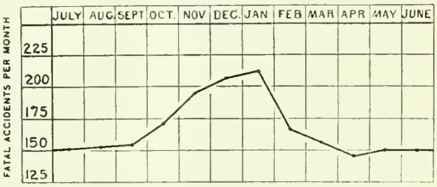


Fig. 1.—Relation of daylight to accidents.

tion is provided. In these cases the men worked in a small zone, very brightly lighted, and when it was necessary to move out of this zone for any reason, the eye was unable to adapt itself to the lower intensity with sufficient quickness to prevent stumbling over obstacles.

It is suggested that where moderate local illumination is used a minimum general illumination of about 0.2 foot-candle should be provided in all parts of the working space and where the local illumination is high or where the work is done on bright metal parts, highly reflective surfaces, or locations with moving machinery, this general illumination should be raised to about a minimum of 0.5 foot-candle.

Perhaps the greatest number of accidents due to inadequate illumination are caused by falls, and from the report of the British factory inspectors for 1911 it appears that for 379 fatal accidents caused by machinery moved by mechanical power there were also 377 due to persons falling. Very few industries are exempt from this danger, and it is especially true in building construction, ship building yards, and machine shops where the working area is very large in compari-

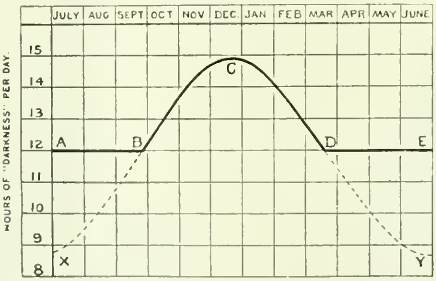


Fig. 2. Working hours of darkness, by month.

son with the number of men employed, and where the system of lighting could be described as illuminated spots around where the work is done most of the time, with large dark areas intervening.

Most managers provide sufficient light for the immediate working space and pay no attention to the stairways and halls, with the result that many fatal accidents are due to this cause.

Much harmful lighting has been caused by the introduction of the high efficiency tungsten lamps without due regard to the increase in the brightness of the filament. In many cases tungsten filament lamps have simply replaced carbon lamps without any reflector, or simply with some inadequate devise that did not cover the filament. Thus while the aggregate candle-power in many factories has been increased, the bad effects of glare have in many cases made the conditions worse rather than better.

There is a crying need for a greater concentration of effort for the protection of the ultimate consumer of light—the eye. Engineers and chemists have evolved lighting units which if properly applied, will produce adequate illumination in our factories at a cost so slight that it is out of all proportion to its importance.

New Pull Switch Rosettes

The accompanying illustration shows new types of pull switch rosettes manufactured by Pass & Seymour, Inc., and embodying the Fluto interchangeable feature. These rosettes are all supplied with a short chain to which is added ten feet of black linen cord and black acorn permitting the use of the eyelet or pulley to which the cord may be carried to en-

able it to be operated at some distance. It will be noted from the illustrations that a wide range of bases is provided permitting the use of these rosettes on cleat work, outlet box work or ordinary concealed wall work, as well as for taplets, conduit box, adapti work, etc.

The Canadian Laco-Philips Company, Limited

The Laco-Philips Company of New York have sent out notices advising the incorporation of the Canadian Laco-Philips Company which has acquired the Canadian business of the parent company. It is stated that all the Canadian lamp contracts have been taken over by the new company and that hereafter all Canadian orders for Laco lamps will be attended to by the new company.

The Dealer and Contractor

The Percentage System in Electrical Contracting

A system of charging that is making considerable headway in the electrical contracting business is that computed on a cost plus percentage basis. For the less experienced contractor there is much to commend this practice in that he avoids some of the disastrous under-estimates which have been the means of too often putting the beginner out of business. On the other hand, it is a difficult matter to decide just what the word cost should be interpreted to mean and to determine just what percentage addition is reasonable. Contractors, as a whole, undoubtedly still incline to the opinion that the straight competition, taking into consideration not only price but also skill, reputation, etc., is the most satisfactory for all parties. The percentage system, however, has many friends. In this connection an interesting paper appears in a recent issue of the Electrical Review by Mr. G. D. Crain, Jr., which views the matter from both sides. We print this paper in part below.

One of the most important and interesting developments in the electrical contracting business, as in other departments of building construction work, is the use of the percentage system. As the name suggests, this plan involves awarding business to the contractor on a basis of an agreed percentage above the cost of labor and materials.

The defects of the system of bidding are obvious. In the first place, there is an element of uncertainty which sometimes results in the contractor handling an important job at an actual loss. Unforeseen elements of difficulty may arise, and the delay and increased expense thus made necessary eliminate all possibility of earning a profit.

The average owner is willing that the contractor make a fair profit on his work; and it is also plain that if a contractor sees that he is likely to lose money on a job he will be tempted to "cut the corners" wherever possible for the sake of making his net loss as small as possible. This does not always happen, of course, for many concerns would rather lose money on a piece of work than risk losing the good-will of the customer. Nevertheless, the temptation to slight the quality when it is found that a bid which is too low to cover the cost has been made, is present, and it doubtless has its effect in a good many cases.

On the other hand, the very fact that the wise contractor appreciates the risk involved in bidding, since it is never possible to anticipate every feature which may arise, means that a larger margin must be allowed to take care of the unknown quantities than would be necessary if every point were covered by the bid. The contractor who would be willing to make 15 per cent. "for sure" on every job will probably allow 25 per cent. in bidding in order to cover the unexpected difficulties that may arise, and also to take care of other jobs where the net had been considerably below the expected profit.

That means that in some cases the owner pays more than a fair price for the job. He is helping to average up the general run of work, and his excess payment offsets the too small amount charged on an unprofitable job. This is obviously an inequitable system, and furnishes a legitimate argument for the use of the percentage system.

One of the chief advantages to the contractor is that he can get the benefit of accumulated good-will and the prestige which goes with a record of big jobs well handled. While it is not necessary that the architect let the contract in every case to the low bidder, the inclination is always in that direction, and thus the inexperienced and the unskilled, who know neither how to figure the cost of a job nor how to handle it to the best advantage, are likely to get work to which those who have proved themselves in previous jobs are really entitled. That is one of the glaring weaknesses of the present system. The lowest and best bidder is the man to whom the contract, in theory, should be awarded, but in actual practice it is the low man more often than the best who gets the business. Contractors have learned this, and know that only when their bid is pretty close to the bottom will they be given serious consideration.

The percentage system eliminates all this. It puts a premium on efficiency and high-grade work. If the Johnson Electrical Company did an excellent piece of work in wiring a storeroom for James Martin, architect, and Mr. Martin has another job in which particularly careful work is required, he would much rather be sure of Johnson getting it, by making a percentage agreement, than have to take bids and feel called upon to let the contract to the low man, irrespective of his previous record, and without regard to whether the architect himself had tried him out on other work. That makes the percentage plan easy and convenient for the architect.

Then, too, many an owner has a friend in the business whom he would like to favor. Under the open bidding system he does not feel justified in apparently throwing away money merely to favor a friend. Consequently if somebody else bids lower than the concern he is acquainted with, it is seldom he interposes a request to give the contract to the higher man. With the percentage system, he can do this without feeling that he is making the job cost him more than a fair price. He is sure of getting it at a proper charge, for labor plus material plus profit should be easy to figure.

It must not be thought, however, that the percentage idea solves all problems, and makes life's path easy for the contractor. There are difficulties and irritations involved here as well as under any other system, for no change in methods will change human nature. The contractor who is inclined to beat the owner under a bidding system will probably attempt the same thing under a percentage plan.

In fact, cases have been cited in which the contractor padded his expense bills, charging the owner the list price for material, without showing the discounts received. Time for labor was also increased, helpers being put in at mechanics' prices, and other features of that kind developing. Carelessness in buying and using material when the owner is footing the bill is also apparent in some jobs handled on a

percentage plan, and when this occurs the system is given a bad name.

Another difficulty is determining just what the percentage should be. And, after all, here is an opportunity for bidders to be pitted against each other, for the man who agrees to do the work for the smallest percentage over and above the cost of the material and labor, other things being equal, is likely to get the job. So adopting this plan does not entirely solve the problem, by any means.

One large contractor in an Ohio Valley city believes that 20 per cent. plus a proper charge for supervision, is a fair basis on which to handle the business. He points out that he is entitled to a profit both on the material used and on the labor supplied, and that it likewise costs money to have the work properly supervised, supervision not being included in the labor item, as a rule. But sometimes he finds that other contractors are willing to eliminate the supervision charge, and also to shrink the percentage of profit, the incentive to the man who has no very high principles for the conduct of his business being so obvious that a good many of them will take the work for almost nothing in order to have an opportunity to make money by "faking" their bills

"The percentage plan has been given undeserved unpopularity among certain owners and architects," said the head of the concern referred to above, "because of their experience in dealing with contractors who did not play fair. It might be said that under such a system the owner would be foolish to give his work to anybody except those he knows he can trust completely. But if one man is willing to work for a smaller margin of profit than another, he is likely to be given the work. The contractor of this kind may think that it is legitimate to make up for a narrow margin of profit by padding his bills, and get his profit in some other way; but we believe in laying all our cards on the table and stating in the beginning just what the charge is going to be, above the cost of labor and material."

A phase of the plan which seems to meet the objection that the contractor has no incentive to work out effective methods of cutting costs and reducing the expense of a job, in view of the entire cost being borne by the owner, is the award of a bonus. The architect figures an estimate, which is agreed upon as representing the probable cost of the job, and the contractor gets 50 per cent. of any saving made in the work compared with the original estimate. This makes it worth the while of the contractor to reduce the expense wherever it can legitimately be accomplished, and gives him something to work for. This plan has been used successfully in a good many cases.

The percentage idea is undoubtedly interesting. It has its defects and drawbacks, but appears on the whole to mark an improvement over the typical system.

300 to 5,000 Volt. A.C. Lightning Arresters

The essential functions of good lightning arresters are threefold.

(1) They must be sufficiently sensitive to discharge to earth abnormal transient stresses of potentials slightly higher than normal line voltage.

(2) They must be capable of instantaneously restoring the circuit to its normal condition by cutting off the flow of dynamic current which tends to follow in the path of the static discharge.

(3) They must be capable of restoring themselves to their normal condition instantaneously so as to be ready to earth the rapidly recurring discharges, which usually make up a lightning stroke.

The Canadian General Electric Company announce that they offer two types of arresters embodying features which take care of the duties outlined above. These are known respectively as the Graded Shunt Multigap and the Compression Chamber Multigap lightning arresters. They are both designed with low uniform resistance, the resistance rods being glazed to prevent scintillating, or arcing over, from end to end. The gaps in the graded shunt type are mostly shunted by resistances, offering a selection of paths to earth for the discharge. The compression chamber type employs a smaller number of gaps, their sensitiveness being enhanced by the effect of the antennae placed in close proximity. The flow of dynamic current is positively and practically instantaneously cut off in both these types by the rectifying properties of the vapors emitted from the gap metal, which interrupts the flow of current and extinguishes the arc at the end of the half cycle. No moving parts are used in either type of arrester, and therefore there is no time elapsing when the arrester is not ready for duty. This is particularly important in the case of rapid recurring discharges. The lack of moving parts also eliminates the necessity of frequent inspection and adjustment, due to the liability of moving parts to get out of order. Graded shunt and compression crusher arresters protect, and are not designed to save themselves at the expense of the equipment they are installed to protect.

Electric Impulse Clocks

The illustration herewith represents a type of impulse clock manufactured by Gent & Company, Leicester, England. This company manufactures what is known as the Pulsynetic system of electric impulse clocks for indicating uniform and correct time throughout residences, hotels, institutions of various sorts, works, factories, etc. This modern impulse clock system consists of (a) an impulse transmitter; (b) the clocks or impulse dials; (c) wiring. Every dial in the whole system is absolutely governed by a transmitter which has a compensated pendulum guaranteed to within a few seconds

per week so that uniform time and correct time is maintained on every dial. This system of impulse clocks can be extended indefinitely both as regards number and size of dials. Gent & Company have also just published interesting catalogues covering their patent electric watchman's and tell-tale clocks designed for checking the movements of night watchmen in warehouses, factories, mills, hotels, etc., and for assuring strict attention to duty on the part of night nurses and attendants in asylums and hospitals. Another catalogue illustrates and describes their secret inter-communication telephones.

Escher Wyss & Company, Montreal, have received an order from the City of Edmonton for a 6,000 kw. Zoelly steam turbine set, running at 1,800 r.p.m.

Five Degrees of Light

There has recently been put on the market a device called the Dim-a-lite which makes any lamp a "Turn down lamp." This device is merely a small rheostat which can be attached to any lamp socket. It is constructed as illustrated herewith. The device is suitable for any lamp and any current and may be attached in a few seconds. The pulling of the chain gives five degrees of light: "full," "dim," "low," "night light," and

"out." The Dim-a-lite makes an ideal hall light for any room. The ordinary electric light is often too bright when turned up and leaves total darkness when turned out. Another point about the device is that at the low lights there is a saving of current. Tests made in the Bureau of Standards, Washington, show approximately a saving of 75 per cent. at the lowest light. These devices are being sold in Canada by the Benjamin Electric Manufacturing Company of Canada, Limited, Toronto.

Travelling Trolleys

We have just received from the Herbert Morris Crane & Hoist Company, a copy of their newly issued bulletin B5 which is entirely devoted to the various types of travelling trolleys made by this company. These Morris trolleys are of many patterns to run either on a flat-bar track, or on the lower flange of an ordinary steel I-beam. Some of them are prepared for short straight runways, while others, containing suitable swivels, are flexible in a horizontal direction, and thus permit of the use of curves or "bends" in the track. The bulletin contains a great deal of practical information of immediate interest to all users of this kind of equipment. The illustrations, diagrams and tables of dimensions and prices are arranged in a handy and useful form.

New Resistance Casing for I-C Starting Rheostats

The Independent Electric Manufacturing Company of Milwaukee, Wis., have developed and are placing on the market a new type of resistance casing for starting rheostats and controllers. The casing or the resistance box itself, in which the resistance units are mounted, is of cast iron and in the sides of the box, at the top and the bottom, there are four large ventilating openings. These openings are covered with heavy non-corroding screens of fine mesh which allow free passage of air into the box and positively prevent any sparks or flames emanating from the box in case of a burn-out of the units, the principle being the same as on the safety lamps which have been employed successfully for years in the mining industry. There are no external openings whatever in the bottom plate of the box so that should a burn-out occur, the molten parts dropping to the bottom of the box are absolutely prevented from falling to the floor. This box has been examined and approved by the Underwriters' Laboratories.

German Glassware in Canada

Max Kray & Company, Berlin, Germany, one of the largest manufacturers of lighting glassware in the world, have made arrangements for placing their line in this country. Rau, Voss & Company, with offices at 162 Bay Street, Toronto, will be the sole Canadian agents. This office is now operating, under the management of Mr. G. Helliken. Rau, Voss & Company will carry a complete stock of their very extensive line of small gas and electric shades, globes and balls, also a line of dishes, bowls and urns for semi indirect lighting in a variety of glasses, treatments and decorations. In addition to the above specialties they will carry the regular staples, air hole chimneys, electric bulbs, etc. Of particular interest in the line is the special glass which they have named Onyxit, which is capable of innumerable treatments, thus producing an endless variety of effects. Mr. Bernhard Schneider, managing director of the company, is at present in Canada getting the line started.

The Electrose Manufacturing Company, Brooklyn, N.Y., will have an extensive exhibit of their high tension insulators and insulating parts at the Hotel Walton, Broad and Locust Streets, Philadelphia, during the N. E. L. A. convention week.

The Mac Electric Company of Ottawa, have recently added several agencies to their line, extending business in the Ottawa district, among them being the Lindsley Bros. Company, of Spokane, Wash., dealers in cedar poles, and the Thurman Vacuum Cleaner Company, St. Louis.

Trade Publications

Small Motors—Booklet issued by the Robbins & Myers Company, Springfield, Ohio, entitled "Doing the World's Work."

Frequency Meters—Bulletin issued by Roller-Smith Company of Chicago describing the Hartmann & Braun vibrating reed frequency meters, variation alarms and relays.

Rope Drives—Bulletin O issued by the Mesta Machine Company, Pittsburgh, describing the advantage of rope drive and containing information on the length of life of manila ropes.

Water Meters—Bulletin No. 16 issued by Canadian Allis-Chalmers, Limited, describing and illustrating Cochrane hot water meters for which this company are exclusive Canadian agents.

Burke Switches—Folder issued by the Railway & Industrial Engineering Company, Pittsburgh, drawing attention to the valuable features of Burke switches for sectionalizing transmission lines for outdoor stations, etc.

Good Service—A booklet issued by the Electric Maintenance & Repairs Company, Toronto, entitled "The House of Good Service." This booklet is distributed with the object of drawing attention to the different lines this company handle and the kind of work they do.

Pressed Steel Case—Catalogue issued by the Pittsburgh Transformer Company describing their new distributing transformers enclosed in pressed steel cases. The catalogue contains useful information regarding the erection of transformers together with other interesting data.

C. G. E. Publications—The Canadian General Electric Company have issued Bulletin No 43401 entitled "Modern Lighting Practice in the Clothing Industry;" also Bulletin No. 48010 on "Electricity in the Shoe and Leather Industry." Both of these catalogues are well illustrated and contain much useful information.

Buckeye-Mobile—Bulletin No. 111B issued by the Buckeye Engine Company of Salem, Ohio, describing a type of engine which combines in a single unit the ordinary factors of a high grade steam plant, namely, a boiler, engine and all auxiliaries. It is claimed for this apparatus that it will develop a brake horse power on less than $1\frac{1}{2}$ lbs. of coal. It is manufactured in sizes from 75 to 600 B.h.p.

Current News and Notes

Bolton, Que.

The plant of the Bolton Light, Heat & Power Company is valued by the Hydro-electric Power Commission of Ontario at $7,500. The question of the municipality taking over the plant is now under discussion.

Carlyle, Sask.

Work is at present in progress on the erection of a municipal electric distribution system for domestic and street lighting.

Canso, N.S.

The town of Canso will install during the present summer a complete light and power plant. A gas producer engine generator set of 100 h.p. capacity will be put in.

Chatham, Ont.

Negotiations have been opened again for the purchase by the city, of the plant of the Chatham Gas & Electric Company.

Clinton, Ont.

On May 19th hydro-electric power was officially turned on in this town.

Colonsay, Sask.

The Colonsay Rural Telephone Company are calling tenders for the supply of material and the construction of a telephone system.

Dryden, Ont.

A by-law authorizing $7,000 to be spent on a municipal telephone system will be voted on shortly.

Duncan, B.C.

A contract has been awarded to Robert McLay for the construction of a brick power house.

Edmonton, Alta.

Mr. Bion J. Arnold, consulting engineer, Chicago, was in Edmonton on May 18th at the instance of the Edmonton Interurban Railway to advise as to the most economical form of motive power for their line to St. Albert; also as to the advisability of building a line to Fort Saskatchewan eighteen miles east of Edmonton. The car barn and rolling stock consisting of one gasoline electric motor car was destroyed by fire early in April.

Gananoque, Ont.

The Gananoque Electric Light Company have awarded a contract for an addition to their power house.

Gravenhurst, Ont.

A contract has been awarded by the town council to Etler & Clift, Gravenhurst, for the erection of a sub-station required here.

Halifax, N.S.

Premier Murray recently explained in the local house that he had already had a report made by a competent engineer as to the best means of conserving and developing the water powers of the province so that they might be of the greatest value to the citizens at large. It was also stated that a bill would be brought in providing for the appointment of a water power commission whose duty it would be to devise just and practical rules respecting the preservation and control of the running waters and water powers of the province.

Foley Bros., Welsh & Stewart, Ottawa, who have the contract for the depot construction work in Halifax are installing their own electric power equipment. They have already on order two 100 kw., d.c. steam driven generators for construction purposes, including pumping, drilling, lighting, etc.

Halifax Electric Tramway Company are considering the installation of another 2,000 kw. high pressure turbo-generator set.

Kindersley, Sask.

The South Valley Telephone Company have awarded a contract to the Kindersley Construction Company for the erection of their telephone system.

Lacombe, Alta.

A by-law will be submitted asking authority to purchase a steam boiler for the electric light plant.

The Lacombe & Blindman Valley Interurban Railway are making good progress with their grade and they expect to have part of it in operation this year. This road will operate a gasoline electric motor car and will eventually connect Lacombe with Edmonton. The right of way is from 10 to 20 miles west of the present Calgary and Edmonton Railway. The order for steel has been placed with the United States Steel Products Company and the order for the motor car will soon be placed.

Lachine, Que.

By a majority of ten to one, the electors of Lachine, P.Q., have passed a by-law for improvements, including a large sum for laying underground conduits.

Leduc, Alta.

A by-law was submitted on May 20 authorizing the expenditure of $15,000 on an electric light system; most of the contracts are already let.

Morse, Sask.

A contract has been awarded to Mr. W. D. Craig, Regina, for the erection of a telephone line for the Morse Rural Telephone Company.

Montreal, P. Q.

Justice Mercier, of Montreal, has decided that an electrical contractor is not bound to do his work in compliance with the regulations of the insurance companies unless it is so stipulated in his contract. The Routtenberg Company ordered a $400 electric sign from the Macey Sign Company, but when the sign was delivered refused to pay for it, claiming the wiring was not up to the Underwriters' standard. The court held that the sign had been made in accordance with all the requirements of the contract, and that therefore payment must be made.

The Nova Scotia Steel and Coal Company have placed an order with Fraser and Chalmers, Montreal, for a 2,000 kw. steam turbine direct connected to an alternator to be supplied by Vickers, Limited, Montreal, including switch gear and complete condensing apparatus.

New Westminster, B.C.

Arrangements have been made for supplying the new Royal Columbian hospital at New Westminster with electricity for four 45 ampere cooking stoves, elevator, return call signal system and laundry.

Niagara Falls, Ont.

By a recent bill at Washington the Secretary of War for the United States is given the right to issue revocable permits for a daily diversion from Niagara River averaging 15,

600 cu. ft. per second on the United States side and for the importation of 250,000 h.p. from the Canadian side.

Ottawa, Ont.

The Ottawa Municipal Electric Commission are now selling electric supplies. On Wednesday, May 20th, the office staff vacated the quarters on the ground floor of the city hall for which a rental of $1,500 had to be paid to the city and moved into larger premises on the ground floor at 207 Sparks Street, within two doors of the corner of Bank and Sparks sterets, the centre of the city, at a rental of $1,890 yearly. The front part of the new quarters will be used as a store and the back part as the offices. The Commission now expect to get considerably more business and the profits on the sale of electr.cal supplies will, it is ant.cipated, more than pay for the increase in the rent.

Pembroke, Ont.

A by-law was recently carried granting a bonus of $5,-000, a loan of $50,000 and fixed assessments to the Electric Manufacturing Company of Canada.

Prince Albert, Sask.

It is expected that a by-law will be submitted in the near future regarding a franchise to be given a private company for the construction of an electric railway.

Prince Rupert, B.C.

In connection with their new hydro-electric undertaking the Prince Rupert Hydro-Electric Company are purchasing a 1,650 h.p. Canadian Allis-Chalmers water wheel direct connected to a Canadian General Electric 4,400 volt generator and direct connected exciter; also a complete switchboard, Tirrill regnlator and lightning arrester equipment. This plant is to be designed and erected by the local staff of the corporation, Mr. W. St. George Mason, city engineer, and Mr. T. C. Duncan, electrical engineer. The Prince Rupert company is at present operating with a steam plant of moderate capacity. It is anticipated that with the completion of the hydro-electric scheme a substantial reduction in power rates will be put into force, an innovation which no doubt will be attended by considerable development in the industrial life of the city.

Regina, Sask.

The operation returns for the municipal electric railway system, Regina, for the week ending May 9 are as follows:—revenue, $4,096.50; passengers carried, 97,901; passengers carried including transfers, 109,681. Corresponding figures for week ending May 16 are $3,720.55; 89,039 and 99,960.

Renfrew, Ont.

The council has received an estimate from the Hydro-electric Power Commission of Ontario on the cost of street lighting. The total sum required will be in the neighborhood of $16,000 and it is probable the work will be proceeded with in the early summer.

Revelstoke, B.C.

The city of Revelstoke will install another hydro-electric unit this summer and have purchased from Escher, Wyss & Company an 1100 h.p. turbine to operate under a head of 73 feet. An order for a 3-phase, 2300 volt, 750 kv.a. generator with direct connected exciter and switchboard has been placed with the Canadian Westinghouse Company.

St. Thomas, Ont.

The Michigan Central Railway Company have recently installed a small isolated plant. The engine was supplied by E. Leonard & Sons and a 375 kv.a., 575 volt, 3-phase, 25 cycle generator by the Canadian General Electric Company.

Strathroy, Ont.

Extensions to the street lighting system are contemplated, the work to be carried out during the present summer.

Stratford, Ont.

A by-law recently carried to expend $21,000 on extensions to the street lighting system.

Three Rivers, Que.

The city of Three Rivers, P.Q., have decided on an improved system of electric lighting, and have appointed Mr. James Bennett, Board of Trade, Montreal, their consulting electrical engineer, to draw up plans and specifications. It is intended to carry out at present only a section of the scheme to replace the existing arc lights with single arc lights on ornamental standards, spaced at distances of 180 ft. and 200 ft. Conduits are to be constructed for placing the wires underground. The current will be supplied by the North Shore Power Company. The Counc.l are also considering the question of renewing the franchise for street and private lighting at present held by the North Shore Company.

Toronto, Ont.

The general manager of the Toronto Hydro-electric System, Mr. H. H. Couzens, has been given instructions by the Board of Control to make a thorough investigation into the possibilities of the combination of a stand-by turbo-generating plant with a steam heating plant.

Vegreville, Alta.

The town of Vegreville have let a contract for two vertical, high speed engines to Goldie & McCulloch Company, Limited, of Galt, Ont., and for two 2200 volt, 60 cycle, 3-phase generators of 62½ and 94 kw. capacity respectively, to the Canadian Westinghouse Company; pole line material to the Mainer Electric Company of Winnipeg and copper wire to the Northern Electric Company.

Verdun, Que.

The council have decided on the expenditure of some half million dollars to bury all electric wires in the central portion of the city. Verdun has a population of approximately 30,000. It is understood to be the intention of the council to spread this work over approximately five years.

Wallaceburg, Ont.

A by-law authorizing the purchase of the electric light plant of the Wallaceburg Gas Company is being submitted on May 28.

Waterloo, Ont.

A by-law will be submitted in the township of Waterloo giving authority to expend $18,000 on a municipal telephone system.

Winnipeg, Man.

The Winnipeg Electric Railway Company are extending their line in the municipality of Fort Garry from the end of the present line to St. Norbert. This means an extension of about three miles. The work will be proceeded with at once.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.
Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.
All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Fire Alarm System

The Town of Lunenberg, Nova Scotia, invites tenders for the installation of an up-to-date Fire Alarm System, "Siren" preferred. Town very compact—about 3,000 population.

GEORGE H. LOVE, Town Clerk.

Lunenburg, N.S., May 19, 1914. 11

CITY OF KELOWNA, B. C.

Tenders Wanted

Tenders in duplicate for the supply of the following apparatus F.O.B. cars Kelowna, B.C., will be received by G. H. Dunn, City Clerk, up to 12 o'clock noon on **Thursday, June 11th, 1914**:

One 225 B.h.p., Vertical, Two Crank Compound Steam Engine.

One—Feed Water Heater.

One Independent Air Pump and Jet Condenser.

One 150 Kilowatt, 2300 Volt, Three Phase, 60 cycle, Alternating Current Generator for direct connection to engine.

One—Exciter for direct connection to Generator.

One Switchboard Panel to match present switchboard.

Deposit cheque of 5 per cent. required.

The lowest or any tender not necessarily accepted.

Specifications may be seen after May 25th, 1914, at the following offices:

Canadian Engineer, Montreal.
Canadian Engineer, Winnipeg.
Electrical News, Toronto.
Electrical News, Vancouver.

or may be obtained from the Consulting Engineer's Branch Office at Vernon, B.C.

C. R. YUILL,
Successor to
Mather, Yuill & Company, Limited,
Consulting Engineer.

11

Situations Vacant

Contracting Superintendent

Wanted—Superintendent for electrical contracting business having estimating experience. Apply giving full particulars to Box 26, Electrical News, Toronto. 11-12

Situation Wanted

Wanted

Electrician, thoroughly experienced, installing, operating, maintaining, armature winding and general repairs to a.c. and d.c. machinery, at present employed as chief electrician in a factory, desires change. Will be glad to give further particulars.

11 S. SHA, Three Rivers, P.Q.

Electrical Engineer

Position Wanted—Electrical Engineer, Associate A. I. E. E., age 33. Thirteen years' practical experience with D.C. and A.C. machinery, Accumulators, Line erection and maintenance, High speed steam engines and water power plants. At present in charge of Suction gas plant. Box 11, Electrical News, Toronto. 9-13

Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By
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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, June 15, 1914 No. 12

Long Distance Transmission

The probable future developments in long distance transmission promise more for industrial Canada than any other influence that seems to be at work at the present moment. The potentialities of our undeveloped water powers, though placed at many millions of horse-power, are practically unknown and therefore underestimated. The estimates of the area and depth of the coal fields of western and northern Canada are little more than a guess though they indicate a practically inexhaustible power supply. Our power possibilities seem almost infinite. We have to admit the fact, however, that both our coal and water power supplies are not distributed as evenly over the Dominion as in our present state of development we could have wished.

An abundance of energy is the ultimate necessity of industrial life and it follows that our activities must either centre around these localities where power is available or power must be distributed. Up to the present the former alternative has ruled, but this must result ultimately in congestion and inconvenience and a discrimination against those sections of the country which are not fortunate enough to contain in themselves the necessary power supplies. In the final analysis, therefore, the general industrial development of our Dominion depends to a very large extent on our ability to distribute power evenly to all sections.

One has only to consider the history of the developments in telephones, telegraphs and railways to foresee the ultimate goal of long distance transmission. Telephone systems formerly consisted of a large number of small isolated installations. Later, with the development of equipment operative over longer distances, these were joined together, until finally we now have a complete net-work stretching from one side of the continent to the other. Telegraphs and steam railways have developed along similar lines and electric railways in many parts of the United States if not in Canada are showing the same inclination to link up together for the mutual benefit both of the operator and the customer.

Already there are signs and prophesies that herein lies the ultimate goal of long distance transmission. The time is not too far distant when with the refinements in electrical equipment and control and the developments in transmitting longer distances, many large local areas will be linked up together and served by one mighty system of electric transmission lines, into which each individual plant shall supply its portion of power. To cover the whole of Canada is only a matter of some 4,000 miles and already we transmit in Ontario almost as many hundreds. Even to-day there is the nucleus of just such a mighty net-work in the southern United States which already boasts service lines covering a distance of approximately 1,000 miles. What ten years ago was ridiculous in its impossibility is a commonplace to-day in high voltage transmission and, with the same rate of advance, 4,000 miles in the next decade is far from being an unlikely dream.

Just think what this would mean. The mighty waters of British Columbia, of the Yukon, of the Mackenzie and Nelson, the millions of northern Ontario, the Ottawa, the St. Lawrence on to the Hamilton Falls (perhaps our biggest single source of supply)—50,000,000, maybe twice fifty, of hydro-electric horse power feeding into one mosquito-net work of transmission lines covering the whole of our Dominion. To say nothing of our coal and gas areas. What other country in the world can look forward to such a future? And this is a source of energy that time will not diminish—it means light and warmth and power in ample supply for hundreds of millions of Canadians for all time to come.

Best Methods of Conservation

At the recent session of the Royal Society of Canada much attention was given to the necessity of best methods of securing the conservation of our natural resources which were defined to be agriculture, the cattle trade, the forest products, the water powers, minerals, fisheries and furs. In his presidential address Dr. Adams stated that we have been blessed with great natural resources but that each and all of these are already showing signs of rapid depletion. While, in the nature of things, this is to be expected of all our mineral deposits, the president pointed out that all our other resources can and ought to be conserved and cultivated so as to yield higher annual returns than at present, increasing in value yearly so that each may be handed over to the succeeding generation in a better and more productive condition than the present one.

Among the more prominent speakers on this subject was Dr. L. V. Herdt who treated more particularly of our water powers and their conservation. He pointed out that conservation doesn't mean hoarding for the use of future generations but means efficient utilization without waste. As an example Dr. Herdt cited the uneconomical production of power using coal as fuel where it is an exceedingly good plant that can utilize 10 per cent of the total energy of the coal, the balance being dissipated as heat or other by-products. On the other hand a hydro-electric plant is now capable of using 70 per cent of the energy contained in the water. It is, therefore, not so much a matter of whether we are able to produce electric energy as cheaply from coal as from water power as it is a matter to be considered that by using coal for power production purposes we actually throw away 90 per cent of one of our exhaustible natural resources. On this basis of calculation even supposing a kw.h. of electric energy can be delivered to the consumer as cheaply by the use of coal as

by the use of water it is to be noted that Canada's national wealth in the one case has been reduced by 90 per cent of the amount of coal consumed while in the other case it has not been reduced at all. Extracts from Dr. Herdt's paper are printed elsewhere in this issue.

Grand Rapids Reservation

The Minister of the Interior has authorized the reservation of all the available Dominion lands contiguous to the Grand Rapids of the Saskatchewan River, in the Province of Manitoba, until such time as the Superintendent of the Dominion Water Power Branch is able to make a definite statement respecting the lands actually required for power purposes at this point. During the summer of 1913 an extensive topographical survey of this important power site was made by the Dominion Water Power Branch, to enable the engineers of the government interested in power and navigation to design a scheme of power development which would realize the best use of the power resources of the river without any impairment of future navigation. The hydrographic investigations that have been under way for the last couple of years show that the river varies from 4,200 second feet at low water to about 160,000 second feet at flood tide. While this variation is very considerable it is thought that sufficient regulation can be provided to make a power development at Grand Rapids a profitable undertaking. In any event, the action of the engineers of the Dominion Water Power Branch in having a thorough survey made and in arranging for reservation of the Dominion land required for power shows that conservation is being carried out in practice as well as in theory.

Hamilton Section C. E. A.

The Hamilton Section of the C. E. A. held its final spring meeting on the evening of June 3 in the section room of the Terminal Building, President Dorland in the chair. This was a "Get-Together and Social Night." The meeting was opened with a piano solo by Mr. Maurice O'Toole; Item No. 2 on the programme was a piano and violin duet by Gordon and Earl Harrison, sons of Conductor Harrison, and these numbers received very hearty applause. Other members taking part in the programme were Mr. W. B. Burtch, Mr. Albert Taylor, recitation from Mr. H. Hall, and Mr. Charles Coats, of 179 Sanford Avenue North, sang several songs which brought forth enthusiastic applause. Mr. Coats is a new comer to Hamilton, and he should make a valuable addition to the musical circles of the city. A discussion took place as to the suitable place to hold the annual summer picnic, Mohawk Park, Brantford, being elected. A committee composed of Messrs. Pratt, Hutton, Choate, Lennox and Fry were chosen to make the necessary arrangements and pick out a suitable date. Liquid refreshments in the shape of lemonade were served; also a plentiful supply of cigars. The members all voted that they had had a very pleasant evening. The meeting closed with the singing of the National Anthem.

Storage Batteries in Fire Fighting

At a recent meeting of the Philadelphia section of the Electric Vehicle Association of America, Chief Walker of the Department of Public Safety, in charge of all the fire apparatus of the city, spoke at length concerning the splendid results obtained by their electrically driven fire apparatus and of his efforts to convince the authorities that electrically driven apparatus would be satisfactory.

Chief Walker described an eleven-mile trial trip of an electrically-drawn fire engine over some of the hilliest roads in the hilly section of the city, and stated that the time made on this trip had never been equalled by any of their gasoline-propelled apparatus. He also described a demonstration run in the crowded business section of the city to reach a box which normally required 11 minutes by horses, and which the electrically-driven apparatus reached in 5 minutes and 13 seconds. The Chief related an amusing anecdote concerning some of the "croakers" of his department on viewing the fire apparatus when it was delivered, saying that they never in the world could start the apparatus, and, a few minutes after, seeing the apparatus on the way to a fire, changed their opinion very quickly, and said that "the whole world itself couldn't stop it." In summing up, the Chief expressed himself as being decidedly of the opinion that for the central zones of the city the electrical apparatus was by long odds the most satisfactory.

The Growing Field of the Electric Truck

There are seventy-five different industries in New York city that use electric trucks. Brewers are most largely represented, nineteen separate breweries using a total of thirty-four electric vehicles. The department stores are a close second with seventeen owners and 262 individual cars. The seven express companies have altogether 197 storage battery cars. The bakeries come next with eight users of 161 cars, and the two central stations have between them 150 cars. Electric general delivery wagons number 68 and eight meat packers together use 67 electrics. Five jewelers use 44 electric cars and ten wholesale dry goods stores employ 35. Next to these in number are the 32 delivery wagons owned by the Fleischmann Yeast Company.

While with its 273 owners and more than 1,700 cars New York probably has the largest fleet of electric commercial trucks in the country, Boston, Chicago, St. Louis, Cleveland, Buffalo and Indianapolis are being rapidly electrified. Pittsburg, also, in spite of the hills, is among the cities with a growing fleet. Five two-ton trucks were shipped this week to the Duquesne Light Company, which already had two light delivery wagons. An effective advertising sign on these Duquesne trucks is the slogan on the battery boxes, "You can do it better with electricity."

N. E. L. A. Convention

The recent convention of the National Electric Light Association held in Philadelphia, June 1-5, is considered the most successful in the history of this association's 37 years existence. The attendance was over 4,000. The most important event was the public policy meeting on Wednesday evening at which such well known guests as Thomas Edison, Charles Brush, and Frank Sprague were present. Mr. Frederic Nicholls, president and managing director of the Canadian General Electric Company was also among the guests. During the convention the interesting announcement was made by Mr. J. M. Wakeman, general manager of the society for electrical development, to the effect that the necessary $200,000 had been pledged for their advertising campaign. At the same time Mr. Wakeman pointed out that this society was not receiving the support it deserved from the central stations.

The Montreal Public Service Corporation have made a competitive offer to that of the Montreal Light, Heat and Power Company for supplying electric light to the city in the districts where underground distribution has to be made in consequence of the building of conduits. The Public Service Corporation's price per lamp, under a six-year contract, is $137 per annum, the company supplying all equipment; under a 16-year contract the price will be $88; the latter price to be reduced to $65 if the city supplies the standards, cables, etc.

The Artistic in Power Buildings

A number of interesting letters have been received in connection with our recent editorial on "ugly power buildings."

Throughout these letters the sentiment has been uniform, that sufficient attention is not given to the architecural design of our elecric buildings. At the same time the opinion is equally uniform that a marked improvement can be effected without additional cost where a proper co-operation and understanding exists between the engineer and the architect.

One of the most interesting letters has been received from Mr. G. R. G. Conway, chief engineer of the British Columbia Electric Railway, whose work along the line of beautifying the exterior of power buildings of this company is being very much appreciated in the coast province. We print Mr. Conway's letter herewith and reproduce also a photograph of their newest hydro-electric power house, one of the most beautiful on the continent in point of simplicity, dignity and proportion.

Editor, "Electrical News," Toronto:

I have read with interest the leading article in your issue of the 15th May with reference to ugly power buildings. The writer has long advocated that there should be greater co-operation between engineers and architects in the matter of the design of buildings connected with engineering projects which are of semi-public importance. Engineers, although primarily dealing with the utilitarian side of things, however, have no right to design these buildings alone, and their architectural attempts generally lead them to load their structures with architectural decoration which they do not understand. It takes the modern engineer the greater part of a busy life to master even one branch of his profession, and it takes the whole of an architect's life to understand his art.

Beautiful power-house design as exemplified in the Lake Buntzen plant of the B.C.E.R. Co.

We should therefore advocate in season and out of season the co-operation of engineers and architects in the design of engineering works; these works are primarily for the use of the community, and in many cases, such as the building of great masonry dams for storing water for power purposes, where structures are built which may last for many centuries, the engineer has no right to inflict ugliness upon the present and coming generations, especially as a fine design is often a question of beautiful proportions and generally costs no more to construct than an ugly one, and not infrequently costs less.

We see this co-operation of engineers and architects in the design of many beautiful bridges, and in some of the great terminal railway stations on the American continent and in Europe, and I think that this co-operation should be carried out to a much greater extent in the designing of power houses than it has been in the past.

As an example of carrying these principles into practice, I am enclosing you a photograph of the new power house at Lake Buntzen for the British Columbia Electric Railway Company, where the architect and engineer have co-operated together with excellent results. The architectural treatment of the building was designed by Messrs. Somervell & Putnam, of Vancouver, and the building, which is at the water's edge with a background of high mountains, can be seen for six or seven miles by all people who are travelling up the North Arm of Vancouver Harbour.

There is no reason at all why we cannot have beautiful designs for the buildings and chimneys of a steam power plant, or for a hydro-electric plant, but we should, though, in every case make these structures express in the design their real function, stating plainly without pretension what they represent. We do not want a steam plant chimney to resemble Cleopatra's Needle, or a power house to look like a temple for the worship of Minerva, but we should, out of politeness to the public, build them with more beauty than the average factory or workshop. The true solution of the question is in a wise co-operation of the two professions—then, and then only, can these structures be made worthy of being called beautiful.

Yours faithfully,

G. R. G. Conway.

Vancouver, B.C., May 28, 1914.

Layer Insulation in Transformer Construction

It is claimed by some designing engineers, that insulation other than the cotton braid, or enamel on the wire, combined with the forced in compound, is sufficient to stand the combined mechanical and electrical stresses which occur at ordinary operating conditions of pole type Transformers.

Windings without layer insulation bring each individual cotton or enamel insulated wire of a given turn in physical contact with from two to six other turns, depending on the location of the turn in the winding. The contact between the turns is very positive, and the tension of each layer above adds to that beneath, so that the lower layer is under comparatively high mechanical stresses. In windings with layer insulation, the maximum number of mechanical contacts between a given turn, and adjacent conductors, is two, and these two contacts are with turns of the same layer. Consequently, neither the mechanical or the electrical stresses are severe.

The normal electrical stresses in a transformer without layer insulation varies from approximately 3 volts between turns in the same layer to 100 volts between adjacent turns in the adjoining layer. Layer insulation is an additional barrier between the adjacent turns in adjoining layers, and therefore limits the electrical stresses between adjacent turns to the difference in potential between the adjacent turns in the same layer, or approximately 3 volts.

The omission of layer insulation gives a greatly reduced safety factor, and will undoubtedly result in shorter lived transformers, than a design equally good in other respects, using layer insulation. Tests have proven that a transformer wound with layer insulation will break down under induced high potential of approximately fifteen times normal potential, and when wound without layer insulation, at five times normal potential, or in other words the layer insulation affords three times the protection between turns.

Transformer failures, after several years of service, are

usually due to the wearing out of the insulation between adjacent turns of adjoining layers; therefore, additional insulation at this point naturally increases their life. The following tabulation will show the preference that should be given to transformers that will give long life.

Assume the following conditions

5 kv.a., 60-cycle, 2200 volt primary, 110/220 volt secondary.

Transformer

Core loss	45 watts
Copper loss	93 watts
First cost	$50.00
Interest	5 per cent.
Depreciation	5 per cent. for 20-year life
Depreciation	10 per cent. for 10-year life
Cost of station equipment	$150.00 per kv.a.
Cost to produce energy expended in core loss	.01 per kw.h.
Cost to produce energy expended in copper loss	.02 per kw.h.

Cost, based on 20 years

Annual cost of operation, based on 20 years life:—	
Core loss—.045 x 24 x 365 x .01	= $3.94
Copper loss—.093 x 4 x 365 x .02	= 2.72
Interest at 5 per cent.	= 2.50
Depreciation at 5 per cent.	= 2.50
Station investment for total losses, $150.00 x .138 x 10 per cent. (depreciation of station taken at 10 per cent.)	= 2.07
Total annual cost	= $13 73

Cost, based on 10 years

Annual cost of operation, based on 10 years life:—	
Core loss—.045 x 24 x 365 x .01	= $3.94
Copper loss—.093 x 4 x 365 x .02	= 2.72
Interest at 5 per cent.	= 2.50
Depreciation at 10 per cent.	= 5.00
Station investment for total losses	= 2.07
Total annual cost	= $16.23

The above tabulation shows that, under the conditions specified, a transformer that will give twenty years life, will save $2.50 per year to the purchaser, over a transformer having the same initial cost and losses, but having a total life of ten years. In other words, a purchaser could afford to pay 50 per cent. more for the twenty-year transformer and still save the extra cost replacing the short lived transformer in service, plus additional costs due to interrupted service.

D. C. Shunt Motor on A. C. Lines

Why won't the direct current shunt motor operate on alternating circuits?

This question has probably been more or less hazy in the minds of operating engineers and men in charge of electrical equipment, specially those who had not given the subject any special study.

Granting that it is clearly understood that a direct current flows continuously in one direction, while the alternating current goes through cycles of changes in direction of flow in very rapid succession, the main reason for the unsatisfactory, or failure of, operation of the d.c. shunt motor on a.c. will be apparent after the following non-mathematical reasoning is digested.

The direction of rotation of a direct current motor is independent of the direction of the current supplied to it. That is, rotation will be in the same direction, even though the current flow is reversed in direction. Theoretically, therefore, any direct current motor should operate on alternating current. But, the important essential is, that the current in the armature and field reverse simultaneously. This is where the shunt motor on a.c. falls down.

With direct currents there is no phase relation of any kind. With alternating currents there is always some phase relation depending upon the impedence in the circuit. With alternating current applied to the shunt motor then, having its armature and field in parallel, we find that the current through the armature is not in phase with the current through the field. As a matter of fact the field current is lagging nearly 90 per cent. behind, due to the high inductance of the many turns of field winding. All the ordinary forms of shunt motors have a high inductive winding.

This "out of phase" relation of the armature and field currents is the only objection in trying to run a shunt motor with a.c., for the following reason:—The ability of a motor to do work depends upon the torque that it can produce. In the shunt motor, the torque results from the repelling action of the stationary field flux and the armature flux, produced by the field current and armature current respectively. It is absolutely essential that there is some field flux and armature flux in one direction at every instant of time, to produce a continuous torque. With direct current this is always so, since there is no change in the direction of current. But, with alternating current this is not so, since the current through the field and armature is reversing continuously and in the shunt motor, with the field flux 90 deg. or one-quarter of a cycle behind the armature flux, the field flux is maximum when the armature flux is zero and the armature flux is maximum when the field flux is zero. It is readily seen then that the essential condition mentioned above is not fulfilled when a.c. is applied to a shunt wound motor, and therefore no appreciable torque is available for doing work satisfactorily.

To overcome the objection of the "out of phase" relation between the armature and field current, the field may be separately excited from a source differing 90 deg. in phase from another source supplied to the armature. That is, the field could be fed by one phase and the armature by the other phase of a two-phase system and in that way the armature current brought approximately into phase with the magnetic flux of the field. Torque would then be produced the same as if direct current were used. However, there would probably be the additional objection of sparking at the commutator due to induced currents when running on a.c., which could not be overcome conveniently and could only be eliminated by a special design such as is incorporated in a.c. series motors used for electric traction, crane and rolling mill service, etc.

Besides, the iron losses due to eddy currents in the field poles of a d.c. motor on a.c. would be comparatively high, because the poles would not be laminated. A.c. motors are always constructed with laminated rotor and stator iron, on that account.

Ordinarily, no attempt would be made to operate a shunt motor on an a.c. circuit for economic reasons, for it would surely be a great deal cheaper eventually to purchase an a.c. motor than to go to the trouble and expense of trying to arrange a suitable means of using a d.c. motor on a.c. Even the ordinary d.c. series motor would not prove entirely satisfactory on an a.c. circuit, on account of commutator troubles that would be inherent, and other features requiring a.c. design.

The annual report of the New Brunswick Telephone Company shows gross earnings of $422,709 and net revenue of $81,327. The number of telephones now in use in the province of New Brunswick is 14,519, an increase of 1,604 during the past year.

Canadian Electrical Association Convention

Program of the Twenty-Fourth Convention, being held in Montreal, at the Ritz-Carlton, June 24, 25, 26

Preparations are about completed for the twenty-fourth annual convention of the Canadian Electrical Association, which will be held in Montreal on June 24-25-26, with headquarters at the Ritz-Carlton Hotel.

No more appropriate place than Montreal can be found in Canada for the meeting of electrical men, as Montreal next to Niagara Falls may now be looked upon as the largest power centre in Canada. The power situation in Montreal is in the hands of two progressive private corporations. The Montreal Tramways Company through the Public Service Corporation control the street railway system, the generating plant of the Canadian Light & Power Company and a number of smaller electric companies which formerly operated as individual concerns but have now practically lost their identity in the parent organization. The power and light supply is almost entirely in the hands of the Shawinigan Water & Power Company, who generate, and the Montreal Light, Heat & Power Company who distribute and with these is intimately associated the Cedars Rapids Manufacturing & Power Company whose plant is at present under construction. With the completion of this latter plant the total amount of electric power developed in the neighborhood of Montreal will approximate 400,000 h.p.

The papers programme which promises to be productive of much interesting and useful information is given herewith, as is also the very attractive-looking programme in store for the ladies. The Electrical Fraternity of Montreal evidently intend to uphold their reputation as good entertainers.

PROGRAMME OF PAPERS AND REPORTS

Wednesday, June 24th

10.00 a.m. Opening Session.
President's Address.
Secretary-Treasurer's Report.
Report of Auditors.
Correspondence.
Reports of Committees.
"Modern Switching Equipment"—L. B. Chubbuck, Canadian Westinghouse Co.

2.00 p.m. "The Legal Aspect of Interference Between Systems of Electrical Companies"—G. H. Montgomery, K.C., Brown and McMichael.
"Safety First"—J. F. H. Wyse, Organizer & Engineer of the Ontario Safety League.
"Grounding of Distribution Circuits"—S. B. Hood, Toronto Electric Light Company.

Thursday, June 25th

9.30 a.m. "The Value of Electric Heating Devices to the Central Station"—Harold S. Brown, Canadian General Electric Company.
"Co-operation in the Selling of Heating & Cooking Appliances"—W. B. Johnson, Montreal Light, Heat & Power Company.
"Maximum Demand"—P. T. Davies, Montreal Light, Heat & Power Company.
"Report on Work of N.E.L.A. Meter Committee" —G. W. Magalhaes, Toronto Electric Light Co. (Mr. Magalhaes is also arranging an interesting exhibit of demand watt-meters).

2.00 p.m. "Notes on Electrification of Steam Railways"—J. A. Shaw, Canadian Pacific Railway Company.

Friday, June 26th

9.30 a.m. "Interruptions on Long Distance Transmission Lines, their origin and means of prevention"—P. Ackerman, Toronto Power Company.
"High Efficiency Incandescent Lamps and Their Application"—H. H. Magdfick, General Electric Company.
Held over papers and discussions.

2.00 p.m. Executive Session—Election of officers, etc.

ENTERTAINMENT PROGRAMME

Wednesday, June 24th.

10.00 a.m.—Civic Reception at Ritz-Carlton.
11.15 a.m.—Ladies to Country Club, St. Lambert.
1.00 p.m.—Lunch at Country Club.
4.00 p.m.—Tea on R.M.S. "Ascania" Cunard Line.
Boat Races and Life-Saving demonstrations.
9.00 p.m.—Smoking Concert at Ritz.

Thursday, June 25th

10.00 a.m.—Visits to places of interest.
Bell Telephone Exchange.
Mountain Top.
3.00 p.m.—Cars to Lachine.
Down Rapids to "Duchess of York."
Visit to Harbor.
Visit to Vickers Dry Dock.
7.30 p.m.—Dinner at Dominion Park.
Return by M. S. R.

Friday, June 26th.

10.00 a.m.—Shopping.
2.00 p.m.—Ladies and gentlemen cars to St. Cesaire, guests of Southern Counties Railway.
5.00 p.m.—Tea at Ritz-Carlton, Souvenirs.
8.00 p.m.—Theatre Party, Princess Theatre.

LOCAL COMMITTEES

Montreal Local Committees have been appointed as follows:—

General Committee:—Major Hutcheson and Mr. J. S. Norris, Joint Chairman, Messrs. L. D. McFarlane, E. F. Sise, G. H. Olney, R. S. Kelsch, R. J. Jones, J. M. Robertson and Dr. L. A. Herdt.

Ways and Means Committee:—Mr. Julian C. Smith, Chairman, Messrs. K. B. Thornton, J. A. Shaw, R. H. Balfour, W. F. Graves and R. F. Morkill.

Entertainment Committee:—Mr. Lawford Grant, Chairman, Alderman Boyd, Messrs. Paul Sise, R. G. Harris, W. C. Lancaster, W. H. Winter, H. C. Post, P. Roper, Powell and R. M. Wilson.

Publicity Committee:—Mr. S. W. Smith, Chairman, Messrs. W. J. Doherty and L. J. Belnap.

Finance Committee: Mr. J. W. Pilcher, Chairman, C. F. Medbury, F. W. Smith, R. M. Wilson and L. J. Belnap. P. T. Davies, Hon. Secretary.

Montreal a Centre of Electric Activity

Brief Description of the Chief Features, Including the Cedars Rapids Manufacturing and Power Plant Construction to Date

Work on the new hydro-electric development of the Cedars Rapids Manufacturing & Power Company on the St. Lawrence River is progressing rapidly, and the company expect to be in a position to generate power by December next.

This development, when completed, will be the largest low head proposition in Canada. The development is located at Cedar Rapids, on the north shore of the St. Lawrence River, some thirty or thirty-five miles west of Montreal. The location of the development is ideal owing to the fact that a full supply of water is available at all times and seasons of the year, the company having the right to the necessary water supply for the full contemplated development at all times. The amount of water taken for the full development will in no way affect navigation.

The present development will be for 100,000 horse power and the final development 160,000 horse power. The head available on the turbines will be thirty feet. Contracts have been made for the sale of the total available supply of power of the first development, so that the company will be in a very favorable position from the start. The design and construction of the development have been made with the utmost care, the main object being to secure continuity of operation.

The work is of considerable magnitude and covers a great deal of ground, the distance from the entrance works to the end of the tail race being approximately two miles. In Fig. 1, which shows a plan view of the development, the main features may be seen. The water enters a canal, which is some 12,000 feet long, at the end of which, at right angles, stands the power house, the substructure of which acts as a dam giving an effective head of thirty feet on the turbine wheels. The power house contains only the generating equipment, the transformers and low tension bus-bars and high tension switching apparatus being housed in the step-up-transformer house.

The construction of the canal or head race has entailed considerable excavation work, necessitating the removal of some 1,500,000 cu. yds. of earth and 600,000 cu. yds. of rock. This excavation is being done in the dry, being accomplished by sinking a crib dam along the southern boundary of the development. The crib continues down and around the end of the tail race. The south bank of the canal is a rock and earth filled dam. A typical cross-section of this dam is shown in Fig. 2. This bank extends from Isle aux Vaches at the upper end of the development right down as far as the power house and has been formed by means of dumping the material excavated from other portions of the work. The north bank of the canal is formed by means of dumping earth along the shore line bringing the river bank up to the necessary elevation to avoid flooding of the country north of the development when the water is let into the canal. In order to take care of the drainage area immediately north of the development a large ditch has been excavated along the northern boundary of the company's property at some little distance back from the north bank. This ditch drains directly into the tail race.

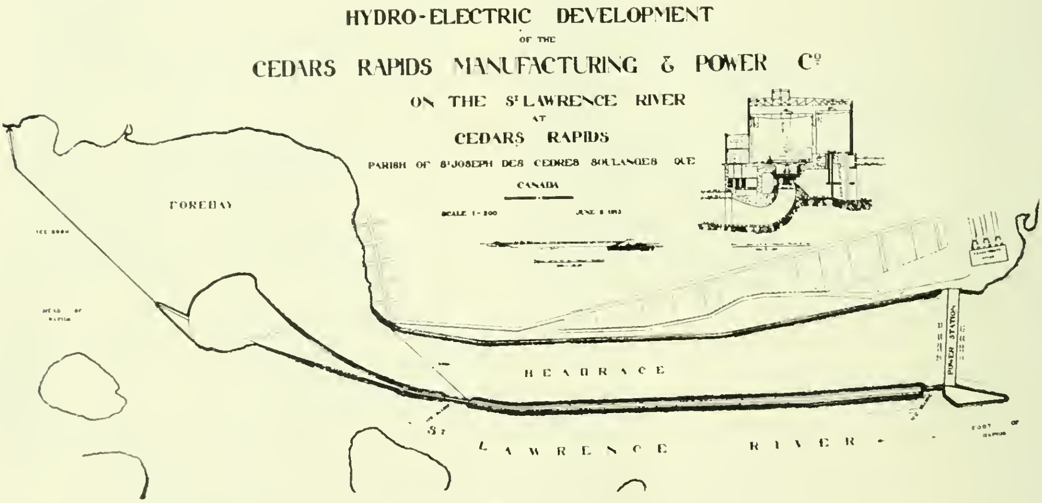


Fig. 1. General plan of Cedars Rapids Manufacturing and Power Company's Development.

In the south bank two ice sluices have been located, one about 3,000 ft. from the entrance of the canal and the other at the power house end. These have been provided to get rid of floating ice, and are formed by a series of concrete piers with overflow weirs in between. The openings between these piers above the overflow weirs will be filled in with stop logs.

The power house, which stands at the end of the canal, consists of a substructure of reinforced concrete, on which stands a superstructure built of steel and reinforced concrete. The total length of the power house for the first development is about 663 ft. Fig. 3 shows a typical cross-section of the power house, and it will be noted from this that the substructure has been so designed as to embrace the

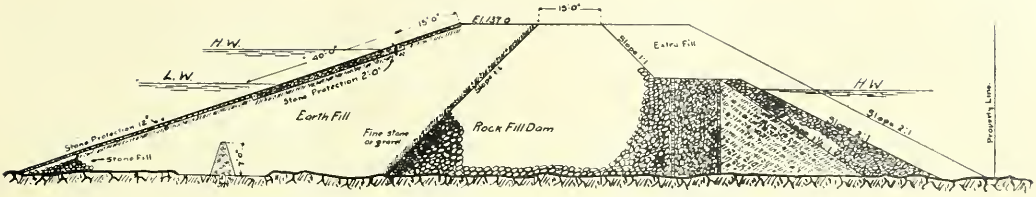


Fig. 2—Typical cross-section of dam at south bank of canal—Cedars Rapids Mfg. and Power Co.

water passage for the turbines. Water flows through these passages to the turbine runner and from there is discharged downwards through the draft tube into the tail race, excavation for this latter having been continued about one thousand feet from the power house, the grade rising gradually from the end of the draft tubes.

The generating equipment in the power house for the first development will consist of 9-10,800 h.p., 56 r.p.m., single runner vertical inward flow turbines, and to each of these turbines will be connected a 10,000 kv.a., 3-phase, 6,600 volt, 60-cycle vertical generator of the revolving field type. There are also three 1,500 h.p. turbines of the same type as the large units and having a speed of 150 r.p.m., and to each of these is attached a 1,250 kv.a., 3-phase, 2,300 volt, 60-cycle, vertical water-wheel driven generator of the same type as the larger units. Three of the 10,800 h.p. turbines are being supplied by the Wellman, Seaver, Morgan Company, Cleveland, Ohio, and the remaining turbine equipment by the I. P. Morris Com-

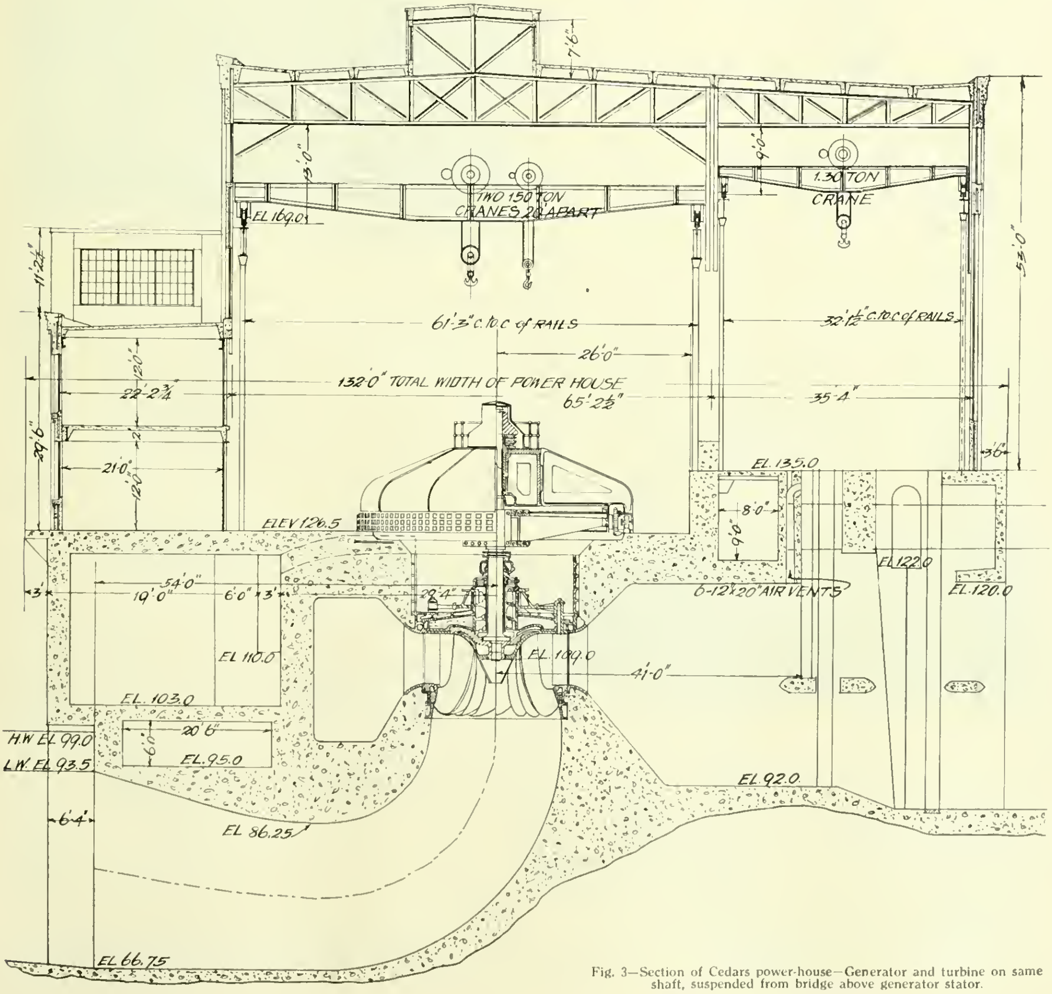


Fig. 3—Section of Cedars power-house—Generator and turbine on same shaft, suspended from bridge above generator stator.

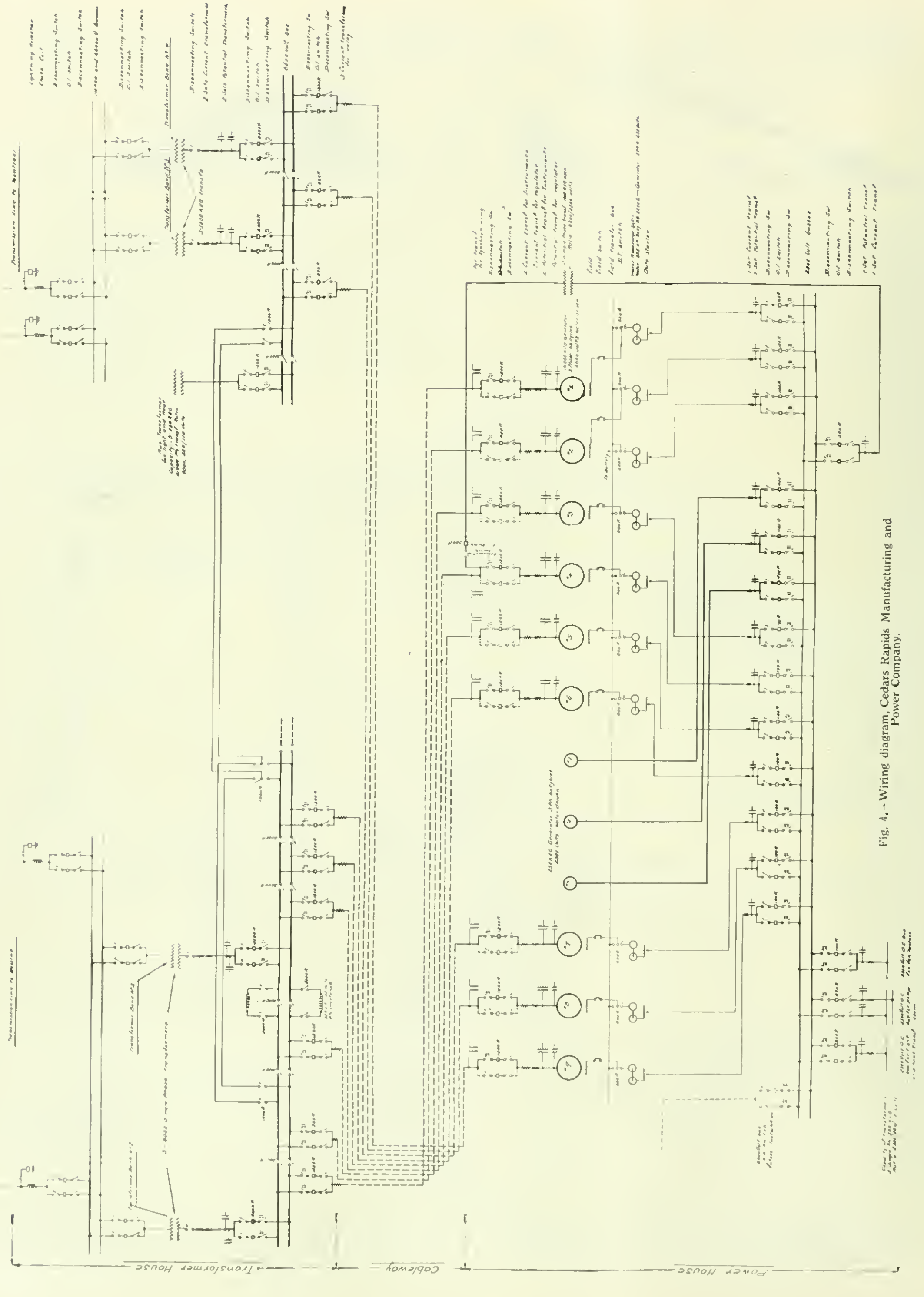
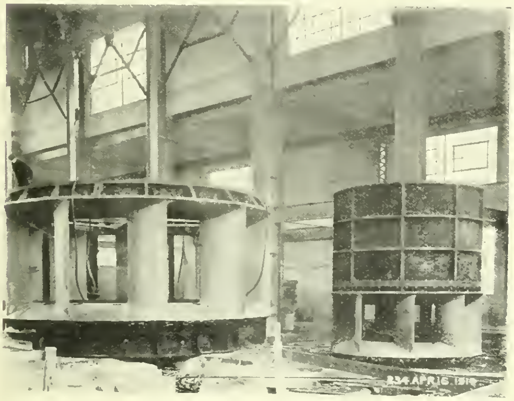


Fig. 4.—Wiring diagram, Cedars Rapids Manufacturing and Power Company.

pany of Philadelphia. This latter company is also furnishing the governors and governor pumping equipment, which consists of four 250 h.p. centrifugal pumps and accessories. In both the 10,800 h.p. and the 1,500 h.p. units the shaft of the generator and turbines is in one piece, the weight of the rotating mass being carried on a Kingsbury thrust bearing, which is supported on a bridge carried on the generator stator. The turbine speed ring is so designed that this weight is transmitted through it to the concrete foundation below.

The generating apparatus is being furnished by the General Electric Company of Schnectady, N.Y. An interesting feature about the arrangement of the plant is the fact that each 10,000 kv.a. generator has its own individual motor-generator exciter set.



Speed rings, main and exciter units—Cedars plant.

These motor-generator sets are driven by 225 h.p. motors, which receive their supply of power from the 1,250 kv.a. generators. The generators of the exciter sets are of 150 kw. capacity supplying direct current at 250 volts to the fields of the main units. The exciter voltage of each set is controlled automatically by means of a Tirrill regulator. The 1,250 kv.a. generators receive their excitation from exciters connected directly on the generator shaft.

Arrangements have also been made for the installation of ventilating equipment in the power house of such capacity that 35,000 cu. ft. of air will be delivered to the wheel pit of each main generator. This ventilating equipment will consist of five sets of fans taking the air through the tail race wall of the building and discharging into an air chamber in the substructure of the power house, from which ducts lead to the wheel pit of each unit. The fans will be driven by 2,200 volt, 3-phase induction motors.

The step-up transformers and low tension bus-bars as before mentioned will be located in a separate building. This building will be of reinforced concrete construction and will be situated approximately 250 ft. from the end of the power house and about 850 ft. from the end of the power house for the present development. Provision has been made in this transformer house for four transformer banks. Two of these banks will be of 24,000 kv.a. capacity, each bank being made up of three 8,000 kv.a., single-phase, 6,600 volt, to 110,000 volt transformers. The other two banks will be of 15,000 kv.a. capacity, each bank being made up of three 5,000 kv.a., single-phase, 6,600 volt to 66,000 volt transformers. The 24,000 kv.a. banks will feed transmission lines running from the development to Messina, N.Y., where 60,000 h.p. will be utilized. The remainder of the power will be transmitted to Montreal by means of transmission lines fed from the 15,000 kv.a. transformer banks. The low tension bus-bars and transformer switchgear for low tension and high tension sides are also located in this transformer house.

Fig. 4 shows the wiring diagram for the development. The switchboard equipment for the plant is divided into three sections, as follows:—

(1) Main control desk in the power house for control of the 10,000 kv.a. units.

(2) 2,300 volt switchboard for control of the 2,300 volt units and accessories.

(3) Control desk and instrument panels in the transformer house for control of the transformer switchgear.

From the main control desk in the power house will be controlled all the oil switches on the main generator circuits, also the electrically operated rheostats and field switches for these circuits. On the back of this control desk the instruments on the generator circuits will be mounted; these instruments are all of the indicating type, except that for each circuit an integrating wattmeter is provided. Signal devices are also provided on this board for interchange of signals between the operator and generator room floor-men.

The 2,300 volt switchboard is of the vertical type, and controls the 1,250 kv.a. exciter generators. The control for the various 2,300 volt circuits in the power house is also on this board. The Tirrill regulators for the automatic control of the 150 kw. exciters are mounted on the induction motor feeder panels, which control the 225 h.p. motors driving these exciters. On the transformer house control board are situated all the controllers operating the oil-switches on the transformer circuits. The transformer instrument panels will be separate from the control desk, and on them will be mounted indicating, graphic and integrating meters for the measurement of the power output of the development. Relays will also be mounted on these panels for the automatic operation of the oil-switches on the transformer citrcuits and also for the generator bus oil switches, which are located in the transformer house, but which are remote controlled from the main control desk in the power house.

Cedars power-house—Up-stream side.

An interesting feature concerning the low tension switch gear of this development is that though the normal operating voltage will be 6600 volts the oil-switch installation has been designed for 13200 volts, as is also the 6600 volt cable work. Similarly the oil-switches on the 2300 volt circuits are designed for operation on 7500 volts, and cable work will be insulated for 4400 volts. The contract for the switchboard equipment and low tension switchgear has been awarded to the General Electric Company of Schenectady, N.Y. In the power house there will be a bank of auxiliary transformers

of 3,000 kv.a. capacity, made up of three 1000 kv.a., single-phase, 6600 volt to 2300 volt, water-cooled transformers. This bank will be fed from one of the main generating circuits and will feed on to the 2300 volt busbars to act as spare capacity in case of a shut down of one or more of the 1250 kv.a generators. Auxiliary transformer banks giving low voltage energy for light, heating and power have been provided in both power and transformer houses.

Another interesting feature of the development and one which has been studied with great care is the feeder cable installation between the generator switches in the power house and the low tension bus-bars in the transformer house. The current from each main generator will be carried to the low tension bus-bars in the transformer house by means of four three-conductor 300,000 c.m. paper-insulated, lead-covered cables, installed in ducts. Special care will be taken to provide a thorough separation between individual cables in order to avoid any danger from a break-down on one of the cables affecting cables of the same or of another circuit. These cables will be protected at the transformer house end by means of relays operating the generator bus oil switches.

The power house will be equipped with two 150-ton cranes for handling the generators and turbines and in the gate room will be installed a thirty-ton crane for handling the gates and racks. A 40-ton travelling hoist will be provided in the transformer house for handling the transformers.

The work at the present time is in an advanced state as will be noted by referring to copy of the last progress report issued by the company on December 1st, 1913. The following are the quantities which have been involved in the construction of this work and which give a good idea of the size and magnitude of this development.

Earth excavation	1,620,000 cu. yds.
Rock excavation	700,000 cu. yds.
Concrete in power house substructure	81,500 cu. yds.

The first work on the development was started in May, 1912, when the crib work on the outside of the south bank was commenced, so that it can be seen that the progress which has been made is remarkable when the difficulties which have been encountered are considered. The work of design and construction has been carried on under the supervision of Mr. Julian C. Smith, vice-president and chief engineer of the Shawinigan Water & Power Company, as hydraulic engineer, and Mr. R. M. Wilson, chief engineer of the Montreal Light, Heat & Power Company, as electrical engineer.

Electrification of the Mount Royal Tunnel

By W. C. Lancaster, C.E., M.E., Fellow A.I.E.E., Member A.S.M.E.*

The Canadian Northern Railway when completed during the present year will be the second transcontinental system to be operated in Canada and will have a total track of more than 10,000 miles. Most of this mileage is in the provinces of Alberta and Saskatchewan, from whose vast grain fields is drawn the traffic which has made the harbor of Montreal the second in importance on the American continent. On this new route from Montreal to Vancouver the grain traffic in a single day often amounts to more than 1,000,000 bushels of wheat. With Montreal the destination for most of this enormous and ever-increasing traffic, it became necessary to provide terminal facilities adequate to prevent any possibility of congestion.

In the absence of a map I will endeavor to describe the electric zone of the Tunnel and Terminal. Starting with the Dorchester Street Terminal as the eastern boundary, the tracks run under the Mountain ascending a .6 per cent. grade all the way. Emerging at the West Portal we find the Model City coach yard and the depressed tracks through that city. West of Model City boundary is located the Quebec Junction with also the crossing of the Jacque Cartier Union Railway, and the Quebec engine change sidings.

At Quebec Junction the Canadian Northern Ontario tracks join those from the tunnel and proceed to Cartierville. Here the trains for the West or vice versa change power. At Cartierville is located the new classification yard which is to be partially electrified. Here also will be located the electric repair and inspection shops. The zone thus defined constitutes about nine route miles of double track. This with sidings and considerable trackage in yards is to be arranged for electric engine operation.

The electrification is unique in that it is not the electrification of an existing time table based upon present steam operation. The engineering calculations have all been based upon a hypothetical foundation prepared from a careful and exhaustive study of train movements, the number of passengers travelling, express and freight traffic statistics, and other factors entering with a terminal study. This examination of Montreal terminals and general Canadian inter and intra province as well as transcontinental passenger travel produced statistics from which the Canadian Northern was able to estimate, with due conservatism, its share of the railroad business originating in, as well as that to terminate in Montreal.

With such an estimate reached and decided upon, a tentative initial schedule was prepared and train weights assumed consistent with modern equipments.

A study of the schedule with respect to the most suitable electric propulsion power resulted in a choice of 2400 volt direct current. Single phase alternating current at 11000 volts and 25 cycle periodicity was considered carefully and dismissed, principally because of the higher initial cost of total installation, due to the combination of the necessity for frequency changer sets and for the high cost of motor coach equipment, which items are a very considerable percentage of the whole investment. Three phase and single phase-poly phase systems were found to be not suitable, because of their inherent motor characteristics of speed; this alone, if the complication of the overhead in the one case, and cumbersome speed control apparatus in the other case were not sufficient reasons for dismissal. The use of the mercury arc rectifier was in a state of experimentation too unstable for serious consideration.

Having determined upon the use of 2400 volts propulsion power, and in reaching this decision very serious consideration was given to its adaptability to future extensions, it may perhaps assist in the explanation of the details of the electrification to travel with the current from its source through its various paths to its return to the source.

A careful canvass of the power supply available on the Island of Montreal or within the scope of a moderate transmission line mileage seems to show that power at 11000 volts and 60 cycle periodicity can be purchased with an assurance of continuity. This assurance of continuity is an equal factor to the consideration of price. We congratulate the travelling public and ourselves, upon the abundance of power de-

* Electrical and Mechanical Engineer Mount Royal Tunnel.

velopments available. So abundant are they that the railroad company is relieved of erecting a stand-by station of its own—be it by steam or water. For the generation of power as well as for stand-by purposes, steam as well as water stations entered into the engineering calculations.

The power will be brought into the terminal sub-station located directly outside of the West Portal of the tunnel, through cables in duplicate running in ducts through the center wall of the tunnel from the Dorchester Street terminal.

In this sub-station the switching is so arranged on the vertical 33 panel switchboard that any incoming line will feed directly to a duplicate set of high tension busses. This switchboard has the usual complement of meters and switch gear, wattmeters, and Tirrill regulator. Provision is made for the installation of an additional main unit set, and its auxiliary circuits, by boards drilled and buttoned. The switchboard controls: a 3.5 kw. motor-generator set for charging battery; station lighting and emergency lighting; auxiliary apparatus transformers; incoming lines, a.c.; outgoing lines, a.c.; exciter sets; traction motor-generator sets; 2400 volt d.c. feeder circuits; electric zone signal mains; tunnel lighting.

The 2400 volt d.c. circuit-breakers are mounted above and to the rear of the operator's position in front of the board, thus providing safe arcing room. These circuit-breakers rupture the circuit in air direct and do not introduce any limiting resistance.

From the busses the power is led to each of the three-phase starting compensators for the main unit motor-generator sets. These compensators are self contained auto-transformers immersed in oil. The main unit sets are two in number for the initial equipment. Space for a third set is provided, to be occupied when traffic shall demand, and the station is so designed that a fourth machine could be installed by a unit addition to the length of the building. The installation of the fourth set seems very remote, however.

These main unit sets each consist of a three unit-four bearing set, mounted upon a common base with the motor between the generators. This is a synchronous motor rated at 12 poles, 2100 kv.a., 600 r.p.m., 11,000 volts, designed for 80 per cent. power-factor running. The two generators of these sets are each rated 6 pole, 750 kw., 600 r.p.m., 1200 volts. This rating is their continuous rating. They are also rated at 150 per cent. load for two hours and have a five minute rating of 300 per cent. load. The two generators are connected in series with their exciting fields connected to the low potential side of the circuit. Each generator while designed for 1200 volt generation is thoroughly insulated against 2400 volt stresses.

The exciting main poles have a compensating winding in the pole face in series with the commutating poles through which current always flows and the purpose of which windings is to neutralize the severe armature reaction arising from heavy over-loads. With this assistance to the commutating poles the proper commutation of the generators is assured.

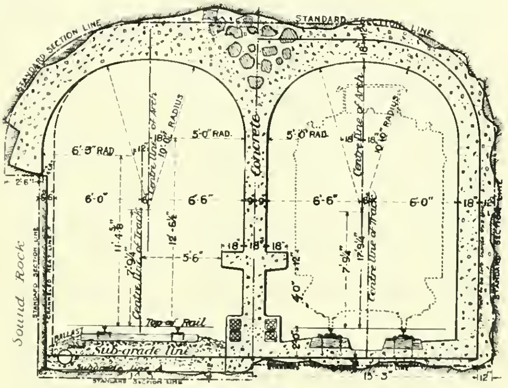
Each main unit is provided with an induction motor generator exciter set. These sets are rated at 50 kw. on the d.c. generator end and are driven by 75 h.p., 550 volt squirrel cage induction motors. Power for these exciters is stepped down from the 11,000 volt busses. There are three exciters provided with one in reserve as spare. These exciters are specified, one to care for two synchronous motor fields and the other one to supply the four generator fields when the two main unit sets are each generating 1500 kw. Each exciter set has an overload capacity sufficient to supply all the excitation for two main unit sets, when emergency should so demand.

The propulsion current is carried to the 2400 volt busses from which the feeder circuits receive their power.

In reviewing the sub-station a word should be said about the building.

It is a reinforced concrete and brick building with steel roof trusses. The face brick is that of tapestry with raked joints. Special attention was given the architecture of this building to conform to the standards set up for buildings in the Model City. The main machine room has a floor area of 4,000 square feet. Back of the room and on the same floor are the bus room, feeder room and the power transformer room. Above these are the oil switch room, the lightning arrester room and the signal and lighting transformers. On the third floor is located the oil switch control batteries.

From the sub-station the power feeds through cable in conduits to the depressed tracks and from thence, runs to the overhead contact circuit. This circuit is designed as a simple catenary system throughout the zone. A steel messenger cable will carry the copper contact wire from the West Portal through to Cartierville. Due to the very low height of contact wire, a condition imposed by the many bridges through the Model City, this wire will be paralleled by a second copper contact wire, the two suspended from



Typical tunnel section.

the messenger cable. This second wire is provided as additional weight with which to counteract the upward pressure of the pantograph. The pole spacing will be 150 feet on tangent track and as the curvature is not in excess of 2 deg. anywhere on the line, approximately 125 ft. will be the minimum spacing.

It is not denitely decided whether a reinforced concrete pole or wood poles of selected cedar will be used. In some cases cross catenary spans will be required, but most of the line will be hung from the familiar "T" iron bracket.

Feeders of bare 250,000 c.m. copper cable will be strung, one cable on each side of the right of way.

In order to obtain at all times and through all temperature ranges, certain predetermined tensions upon the contact wire, a system of anchorages has been designed with automatic tension regulators consisting of weights attached to chains run over sheaves and through insulators attached to the contact wires.

In the tunnel where low clearances are necessary the same double contact wire is to be strung. However, the tunnel catenary cable will not be of steel. Rather than lay feeder cable in conduit in the tunnel it has been decided to string a 400,000 cm. copper cable, as the catenary messenger, which will provide the necessary feeder capacity in parallel

with the two 4/0 contact wires. It is possible that an aluminium cable with a steel center strand and of a cable cross-section equivalent to a copper cable of 400,000 cm. may be used. An investigation of its physical properties when acting as a catenary messenger is now under way. Considerable first cost can be saved if it proves acceptable. In the terminal, the use of a catenary system is doubtful economy because of the intricate pantograph defection work required. An overhead rail perhaps may prove available This detail has not been decided upon.

From the contact wire the current is taken for the propulsion of both cars and locomotives.

The cars are designed as all steel motor coaches. They, of course, have the usual departure from steel construction in the headline, windows, arm rests and interior wainscotting. The motor coaches, already designed, are 65 ft. 6 in. overall dimension with approximately 57 ft. between body corner posts. All doors are swing doors thus permitting ample structural shapes to be used in designing for collision stresses. Reversible seats are located through most of the length of the coach with longitudinal seats at each end.

The cars are arranged for high level platforms at stations, or can be quickly changed to low level conditions. The vestibules are provided with diaphrams which protect from inclement weather when going from coach to coach in the train. Because of tunnel clearances the roof of these coaches will be a "turtle back" design.

The trucks are of the plate frame type, M. C. B. equalized with floating bolster of structural shapes. Both trucks per car are motor operated and are designed with clasp brake rigging. Solid rolled steel wheels are specified.

Current is collected from a pneumatically controlled pantograph. A system of contactor control provides the necessary combinations of circuits for the acceleration and running of the coach. These contactors are solenoid operated switches energized by contacts in the master controller located in the operator's cab. From any master controller in the train, all the motors in the train may be controlled. All motor coaches have double end equipment. In this cab are also located the other control apparatus and auxiliary switches.

The coach is lighted and the auxiliary circuits are fed by a motor-generator set having a 2400 volt motor and a 600 volt d.c. generator. This generator supplies the power for the motor driven air compressor. From taps brought out of the generator, to slip rings, current is collected for the headlights. A highly concentrated tungsten filament lamp of the new gas-filled type supplies the light. The heating of the cars is accomplished by air ducts through which is blown air from across a 2400 volt resistance type heater. The voltage required for the blower type motor is obtained by shunting that motor across sufficient resistance located as near the low potential end of the heater as is possible.

The motor equipment for driving the coaches consists of four 125 h.p. 1200/2400 volt commutating pole, fully ventilated motors. The motors on each truck are connected permanently in series with the fields of both motors connected directly to ground.

Gearing is accomplished through a motor pinion and rolled steel gears cut from a rolled blank. This motor equipment is capable of continuous suburban service when three motor coaches are coupled together and hauling two trail cars. The maximum trains for some time will thus comprise five cars.

The air brake equipment on the motor coaches is similar to that found upon all first class steam railway equipment with the addition of a motorman's control valve.

The locomotives are required to handle the steam trains incoming and outgoing from Montreal. These trains when approaching from the west will change power at Cartierville and proceed into the terminal with electric engines, and vice versa when leaving Montreal. The Quebec Junction engine will handle those trains going east. Two electric locomotives will handle the heavier Transcontinental trains up the 0.6 per cent. grade of the tunnel. The two locomotives will be handled by one engineman. All other trains will require but one locomotive.

The locomotives are of the box cab articulated truck design, weighing approximately 83 tons all on drivers. This design permits of a maximum adhesive weight at all times. The wheel arrangement is known as the 0440 type, meaning no guiding wheels, four wheels per driving truck and no trailing wheels.

Current is collected through two roller pantograph trolleys per locomotive and is brought to the motors through two contactor banks which provide the necessary resistance combinations for acceleration and running.

The operator's compartments in each end contain the usual complement of gauges, meters, controller, auxiliary circuit switches, brake valves and a 2400 volt resistance type radiating heater. Between the operator's compartments is located the control apparatus. Longitudinally are located the two contactor banks, back to back. Directly above in a totally enclosed compartment is located the resistance bank. The heat generated by the resistance grids will be conveyed through ventilators in the roof by air ventilation. At one end of the contactor bank is located the air compressor having a piston displacement of 100 cu. ft. air per minute. The compressor is driven by a 2400 volt motor having two windings and commutators in series. At the other end of the contactor bank is located a 2400 volt motor driving a 125 volt d.c. generator which supplies the auxiliary circuits of the control equipment with power. Direct connected to this set is a blower for ventilating the traction motors.

The trucks are of the rigid bolster type with the end frames and side frames of cast steel, side and cross equalization providing a very efficient suspension. An interesting detail of the drive from the motor is that a gear rim will be shrunk onto an extension of the wheel hub casting instead of a gear shrunk upon the axle. Because of the space required by the motors and the requirement of twin gear drive this method of gearing has been developed. The articulation between the trucks permits all of the buffing and pulling stresses to be transmitted through the trucks and thus relieves the cab structure.

The motor equipment consists of four 315 h.p. 1200-2400 volt motors. These motors are of the usual heavy traction type having twin gearing, box frame, commutating poles and forced ventilation. The motors are nose suspended. Two motors on each truck are connected in series in a permanent manner. These locomotives are geared with a minimum reduction in order to permit reasonable speeds without excessive armature peripheral velocities. This of course limits the tonnage behind the draw bar. About 600 ton trailing passenger trains and 1,000 ton freight trains will be the duty of these locomotives. Only a few freight movements per day will be required of these electric engines. However, at some future time the gearing on these locomotives may be changed to a greater reduction and they at once will handle heavy tonnage service. No other change will be required.

The all-rail return for the propulsion current has been chosen rather than install negative feeder copper. In rather complicated interlocking it may be necessary to run short lengths of cable, but proper return conductivity can be obtained elsewhere by bonding all rails and frequent cross-bonding. The lower amperage in the 2400 volt system assists in the prevention of rail drop. From the rails the re-

turn to the sub-station negative bus is made through cable on conduit.

Further Details

There remain three details of the electrification,—

For the maintenance of the electric rolling stock, there is being designed a shop at Cartierville. This shop will be equipped with the most up-to-date machine tool equipment consisting of such tools as boring mill wheel, turning lathe, wheel press, planer, shaper, forge shop and such sundry appliances. All of the renewal and repair work will be done here. It is planned to handle the locomotive work at one end and the motor coach work at the other end of a long building. The machine bay, located in the middle will thus divide the two classes of work. A 50-ton crane will serve the whole shop.

The stores department will occupy quarters nearby. No trolley power will be brought into the shop. All shifting will be accomplished by an engine or car. There will be provided "pit tracks" for the regular mileage inspection and for easy access to the underneath of the car. Power for the machine tools and lighting will be transmitted from the Terminal Sub-station to the shop as three-phase 11,000 volt power and there stepped down. This transmission line will run along cross arms located on the traction trolley bracket poles.

The electric zone is to be signalled according to the most up-to-date minute standards for safety. All electric interlocking plants are to be installed at the Terminal, Model City, Quebec Junction and Cartierville Yards. All of the high mast signals will be of the three position upper left hand quadrant type with bottom case mechanisms. All dwarfs and switch machines will be motor operated. Signal power will be transmitted at 2300 volts, three-phase, 60 cycles. Electric detector circuits together with approach and route locking are features to be installed.

The tunnel automatic signalling will be accomplished by lights. Both tubes will be signalled in both directions under the control of traffic levers located in the portal towers. The tunnel lighting in both tubes will be accomplished from mains running in the duct line located in the center wall. Both tubes will be lighted consuming about 75 kw. of 3-phase power. The lights will be spaced some 30 feet apart.

Montreal Tramways Recent Developments

The enormous growth of Montreal, particularly in the north and west, has, in the last few years, accentuated the transportation problem—always difficult to solve in cities with populations increasing at great rates. Montreal is peculiar in that it has no suburban railway service to speak of, and has to depend almost entirely upon its tramways for the carriage of passengers in the city and to and from the outlying districts. The consequence of this expansion of population was a congestion of traffic in the rush hours, especially in the central districts. As the population increased, the traffic of the tramways company naturally rose, and as an example of this, we may quote the passengers carried in 1910 with those of 1913. In the former year, when the company was known as the Montreal Street Railway Co., the number of passengers was 107,241,406; last year it was 213,397,325. It should be explained that the latter figures include the traffic of the Montreal Terminal Railway Company and Montreal Park and Island Railway, which with the Suburban Tramway and Power Company are absorbed by the Montreal Tramways Company. But even allowing for this, the increase has been very large. The track mileage in 1892 was 12½ miles; in 1910 it was 144¼ and it is now, for the combined system, 247.

The problem of the congested traffic naturally called for a prompt solution. Negotiations between the company and the city were carried on, and the city agreed to concede new routes and also the re-routing of other lines. The company on its part decided on a very extensive programme of improvements, which is still in progress. With such a very wide area ever increasing in population, the execution of improvements takes a considerable time, but it may be fairly said that the expenditure up to date has resulted in a material amelioration of the congestion. In two years the company have spent over four million dollars on betterments.

In addition to putting on more cars, the company decided to improve the physical condition of the track. Up to the present about 28 miles have been constructed or rebuilt, a portion of work in the former class being due to the new routes and re-routing referred to. The chief problem was to prevent the heaving of the pavement due to frost, which necessitated heavy expenditure on maintenance. The experience of the past winter shows that the new system adopted is successful, and that frost now plays practically no part in the heaving of pavement. The great point in this prevention was the insertion of tile drains beneath the track, allowing the water to flow into the manholes, and thus removing the cause of the destruction of the track.

Under the plans adopted, concrete under the ties in making the pavements was abolished, rolled stone being substituted. In many instances the 87-lb. rails were replaced by 115-lb. grooved rails of a special rolling, and in future this description only will be used. Many new intersections were put in, with clearance curves to enable the cars to turn the corners without interfering with cars coming in other di-

The two-car train used by the Montreal Tramways Company.

rections. While on this subject, it may be mentioned that originally the rear platforms of the cars were nine feet long; these have been reduced by two feet, giving altogether an increased corner capacity of 70 per cent.

Flat tie rods in place of round tie were adopted, thus obtaining a better joint in the paving. A roller rail bender, electrically driven, was recently installed; compromise rail joints were eliminated, and by the use of the thermit weld an almost perfect joint secured. Another improvement was accomplished by the installation of a machine to mechanically offset joints. By these and other means the system has been standardized, this including the rails, spikes, ties, etc. The whole system of track construction was thoroughly studied before the improvements were decided on, with the object of adopting the very best system of modern practice, so that the road-bed would be of a more permanent character and maintenance charges reduced.

The system is now divided into ten sections, with a foreman and gang to each section, which varies from 10 to 30 miles, according to the nature of the traffic. The foremen and men are responsible for the physical condition of their

shocks. In steel cars the slightest shock is apt to start the rivets, but the wooden block absorbs the shock to a very large extent. It is also proposed to install coasting recorders, to register the amount of free running.

The trailers or two-car units—of which we have already given some particulars—have more than satisfied the management. They are spacious, comfortable, and run with great smoothness. The general arrangements make for economy of time and also for safety. The steps and doors are under the control of the motorman and conductors, and there is no possibility of a passenger getting in or out while the car is in motion. When all the doors are closed, an electric light is automatically turned on in front of the motorman, giving the signal to start. The bell signal is eliminated on these cars except in the case of emergency. An emergency door fitted in the rear of the trailer, is operated by means of a tripping lever. Should the cars get separated a semi-automatic service comes at once into operation and the brakes are immediately applied. These cars as well as those of standard type are ventilated by an exhaust system, while in the winter the air comes in under the seats and passing

Map of Montreal Tramways System.

section, and they report periodically on all matters relating to the trackage, repairs, material, etc. This enables the chief engineer to keep an eye on maintenance charges, and also to accurately gauge the cost from week to week.

The new rolling stock is of an exceptionally fine type. About 325 new cars of what is now the standard type have recently been put into service, and in addition 25 two-car units, the latter being on the St. Catherine Street route throughout the day. The colors of the cars are now standardized light olive green for the bodies of the city vehicles, with the windows in cream; light orange for the bodies of suburban cars with the windows also in cream. Several improvements have been embodied in the design of the new cars. Thus, the front doors are now under the control of the motorman; they cannot be opened from the outside, and the motormen have the strictest orders not to open them until the car stops. This is to prevent accidents from passengers alighting while the car is in motion. All the latest type of cars are fitted with wooden shearing blocks placed right behind the main bumper for the purpose of absorbing

under the heater is immediately warmed. All cars are now fitted with seats for conductors and motormen.

One of the most recent developments in connection with the prevention of accidents is the inauguration of a Safety First campaign. This was not confined to the employees, as the company desired the co-operation of the general public, and particularly of the owners of motors and other vehicles. The urgency of taking every precaution was impressed on the men by heart to heart talks, which have proved the most effective method of securing compliance with the instructions of the management. The company have gone beyond the mere talking stage—they have adopted in their latest rolling stock mechanical devices calculated to prevent accidents, and these, added to the precautions taken by the employees and others have materially reduced casualties of every class. The Safety First movement, while of value to the company from the purely economic standpoint, is of equal importance to passengers and pedestrians, as it results in lessening accidents, often due to carelessness on the part of the public.

The Montreal and Southern Counties Ry.

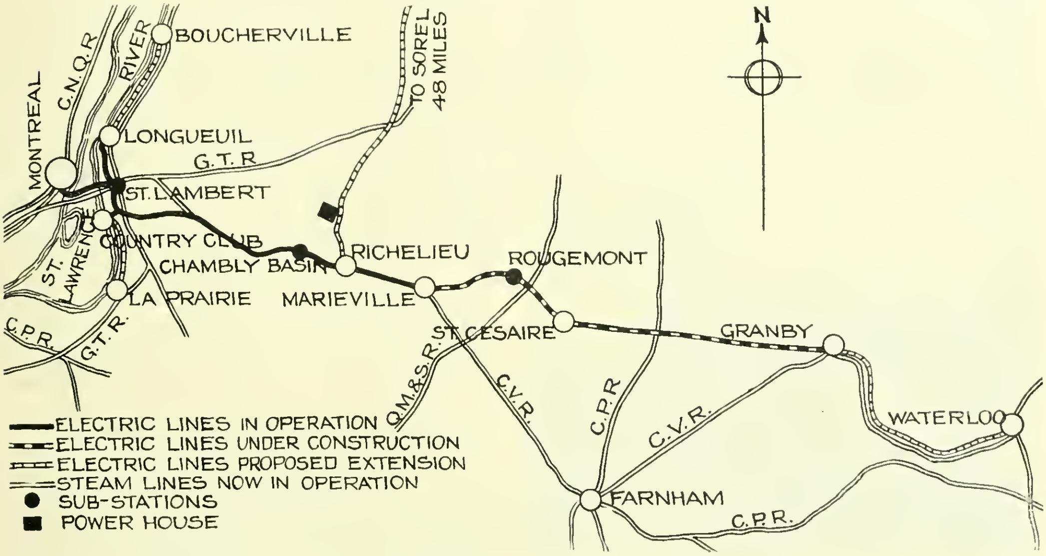
Up to the end of 1909 the facilities for reaching the southern shore of the St. Lawrence were very meagre, and naturally there were comparatively few people resident in the towns immediately opposite Montreal. In November of that year the Montreal and Southern Counties Railway started operations, and since then there has been a gradual expansion of its system. The result has been a steady growth in the population of the south shore, and the opening up of districts which were hitherto of a purely agricultural character. Several important industries have located at favourable points, and when Harbour Commissioners have completed their improvements, it is more than probable that there will be an addition to the plants.

The plans of the company contemplate offering facilities within a radius of 75 miles from Montreal; a large part of that programme has already been carried out, under the direction of Mr. Bion J. Arnold, of Chicago; the contract for the latest extension being from St. Cesaire to Granby, P.Q. The line starts from McGill and Youville streets, Montreal, crosses the St. Lawrence and at St. Lambert divides—one short section going to Longueuil, and the other to Richelieu, Rougemont, and St. Cesaire in which direction all the extensions have been constructed. From Greenfield Park, just beyond St. Lambert, the line reaches Richelieu by the Central Vermont's right-of-way, which has been electrified. At Richelieu the line crosses the Richelieu River, and beyond this point through Marieville to St. Cesaire the Central Vermont's right-of-way has also been electrified. When the line to Granby is finished fifty miles will be in operation. Other projected extensions are from Longueuil to Boucherville, a distance of 5 miles; from the Country Club to Laprairie, 4 miles; and from Richelieu to Sorel, about 48 miles.

Sub-stations have been erected at St. Lambert, Chambly and Rougemont, and another one will be built just outside Granby. Power is supplied from the hydro-electric power station at Chambly Canton belonging to the Montreal Light, Heat and Power Company. The sub-stations have concrete foundations, floors, sills, coping and roofs, supported on steel I-beams, C. I. columns, and brick walls.

The car barns are at St. Lambert; the original structure has a capacity of nine 50 ft. cars and a new one with four entering tracks, a capacity of 16 cars; there are also inspection and repair pits in both barns. Adjacent to the new building are the superintendent's office, despatchers' headquarters, locker rooms, and store houses.

The current from the Montreal Light, Heat and Power Company's power station is 3-phase, 63 cycle, 25,000 volt, and is carried into Montreal, there being a pole line on each side of the track along the Central Vermont Railway. At St. Lambert and Chambly the current is tapped in duplicate and transformed in the Montreal and Southern Counties sub-station at Chambly to 2300 volt and then converted into 600 volts direct current by motor generator set, while at St. Lambert it is changed by rotary converters. This is distributed to the trolley wires over bare aluminium feeder cables.



Map showing present and prospective lines of M. & S. C. Railway Co.

On the latest extensions, the catenary type of overhead construction has been employed. The standard type is used, consisting of 7/16 in. Siemens Martin grade 7 strand galvanized steel messenger cable, from which is hung on tangents at intervals of approximately 13 feet 8½ in., No. 4/0 B & S gauge American standard hard grooved hard drawn copper trolley wire, supplied by the Eugene Phillips Electrical Works, Limited, the Northern Electric Company and the Canada Wire and Cable Company. The hangers are of the floating type, specially designed to neutralize the shocks in transit. Cedar poles are used, spaced 110 and 150 feet on tangents and 90 to 100 feet on curves. Messenger wire is supported on porcelain insulators which are fastened to 10 ft. T iron brackets attached to the poles. With few exceptions the bracket type of construction is used. However, where the curvature or special conditions will not permit,

the messenger wire is supported by cross spans, using 3/8 in. 7-stranded steel cable and pole type porcelain strain insulators. The catenary hangers and miscellaneous material were supplied by the Ohio Brass Company. Along the entire length, the trolley wire is supplemented by bare aluminium feeder with a conductivity equal to 500,000 c.m. copper cable. Part of the feeder cables are supported on malleable iron composition type of insulators of Electric Service Supply Company make and the rest of cables on glass cable insulators carried on standard oak pins, which in turn are supported by 3¼ x 4 in. x 4 ft. pine cross arms attached to the poles with galvanized braces. On the curves the cross arms are double and iron posts are used instead of oak.

The trolley is sectionalized in front of the sub-station and midway between them the section breakers being bridged by disconnecting switches attached to the feeder. During normal operations the sub-stations run parallel. Garton Daniel 625 volt lightning arresters are placed on every tenth pole, and connected to the feeder taps on these poles The Northern Electric Company has installed a telephone despatching system of the selector type of ringing equipment. The line is No. 10 hard drawn copper wire supported on pony glass insulators on side brackets directly attached to the poles supporting the trolley. The telephone wires are transposed at intervals of three poles to overcome the induction from adjacent high tension lines.

Future Extensions

Both in the overhead construction and sub-stations, the work has been laid out to permit of future extensions. At Chambly a 600 h.p., 3-phase, 63 cycle, 2300 volt, 10 pole wire-wound rotor induction motor, made by the Canadian Westinghouse Company, has been installed. This is direct connected to a 400 kw., 600 volt compound wound direct current interpole Westinghouse generator, power being supplied by three 185 kv.a. delta connected oil-insulated self-cooled transformers, high tension 24,000 volt, low tension 2300 volt. The Northern Electric Company supplied the other equipment at Chambly, including the a.c. and d.c. switchboards and line apparatus, Northern type A disconnecting switches and air-cooled choke coils, both 100 amp., 25000 volt, the twenty 5-amp. Wagner o.w.g. 40 current transformers, lightning arresters and the 100 amp. 22000 volt, 3-phase circuit breakers. At St. Lambert there are three Canadian Westinghouse rotary converters each of 500 kw. capacity, 6-phase, 600 volt, d.c., 63 cycles at 945 r.p.m., 8-pole, compound wound, self-starting on the a.c. side from low voltage taps from transformers, and built with shaft extensions to take starting induction motors if needed in the future Connected with each unit are three delta connected 185 kw 24000/428 volt, 63 cycle Westinghouse transformers of the same type as at Chambly; the equipment, duplicating that at Chambly, was also supplied by the Northern Electric Company. From the a.c. line switches run bare copper bus bars. From each transformer to a starting panel run two 600,000 c.m. main leads and two 300,000 c.m. rubber covered double braided starting taps; while from the a.c. starting panel six 600,000 c.m. rubber and lead covered leads are led through three ducts to the machine. There are similar connections for the positive and negative and equalizer generator leads to the d.c. switchboard. Positive feeder cables from the switch on the d.c. board to the outside of the building are 600,000 c.m., r.c.d.b., two cables to each feeder panel.

At Rougemont sub-station a 450 h.p., 3-phase, 63 cycle, 2300 volt, 10-pole wire-wound rotary induction motor direct connected to a 300 kw., 600 volt, compound-wound direct current interpole generator supplied by the Canadian General Electric Company is installed. The transformers are the Canadian General Electric type H, 63 cycle, 150 kv.a., 25,000 volt, with 2300 volt taps on the secondary side. The switchboards, both a.c. and d.c., were furnished by the same company. All wiring in this station is of the open type, No. 1 bare hard drawn copper wire, being used for all inside high tension wiring. All disconnecting switches, oil switches, current transformers, lightning arresters and equipment for the switchboard were supplied by the Canadian General Electric Company.

Rolling Stock

Owing to the loading of the Victoria Bridge, the weight of the rolling stock is limited to 65,000 lbs. each car. The cars originally put into service included 14 single end control, 49 ft. 4 in. by 8 ft. 1 in. cars, with 56 seat standard interurban closed bodies. The motor equipment of each consisted of four Westinghouse 40 h.p., 600 volt, d.c. motors. The trucks are of the standard Curtis type, placed 25 ft. 4 in. centre to centre, 6 ft. wheel base. Westinghouse automatic air brakes with individual compressors and the usual hand brakes are on each motor. Later eight cars built by the Ottawa Car Company were put on to the service. These cars have 50 h.p. at 500 volt d.c. interpole motors. There is seating accommodation for 56 people. Two of the cars have baggage compartments, two are straight passenger, and four are combination smoking and passenger. The Westinghouse type H L multiple unit control system is used, the cars being fitted with Tomlinson automatic couplers. Crouse Hinds luminous arc headlights are used. The car heating system consists of Gold 115E1 heaters in two circuits of 6 and 12 each. Recently ten new cars were received from the National Steel Car Company, of Hamilton. These are 54 ft. 2 in. long with through platforms, and are equipped with water coolers and toilets. The electrical equipment consists of four 50 h.p. interpole induction motors supplied by the Canadian Westinghouse Company, while the brake equipment is of standard Westinghouse automatic design and control is H L, supplied by the same company.

On the Central Vermont tracks the St. Cesaire cars are operated according to standard steam road rules, the despatching of the train being done by telegraph from the office in St. Albans, Vt. The double despatching arrangement permits of the simultaneous operation of the electrical and steam road traffic.

The grades of the road are light, averaging 0.305 per cent., not taking into account the 3½ per cent. at the 550 foot approach to the Victoria Bridge. Near the Country Club where the line crosses the Grand Trunk main line, a special interlocking plant has been installed by the General Railway Signal Company of Canada. The apparatus is housed in a two-storey building. Another crossing of the Grand Trunk tracks at Riverside, near the Victoria Bridge, is controlled by a plant which is only interlocking for the electric line.

On the 8½ miles of track first constructed 80 lb. rails on oak ties are used; while on the extension 60 lb. A.S.C.E. section Dominion rails and splice angle bars were used. Pennsylvania splice bars style D1 were put in on the old 56 ft. rails of the Central Vermont Railway. The track return circuit is connected to the negative bus bars at the switchboards of the sub-stations, while the lightning arresters are grounded at the sub-station in a four foot square tinned copper plate, buried in permanently moist earth, with two foot of crushed charcoal above and below.

The Kirkfield Portland Cement Company have a hydro-electric plant operating on the Gull River at Elliott's Falls near Norland P.O. The head of water is 21 feet. Two Jenckes turbines, 500 h.p. each are direct connected to Canadian General Electric a.c. generators, 500 volts, 3-phase, 25-cycle, 350 amperes. Current is stepped up to 15,000 volts for transmission to the company's works at Raven Lake 16 miles distant. The electrical equipment also includes one exciter unit consisting of turbine and 200 ampere, 125 volt d.c. generator.

Northern Electric's New Wire and Cable Plant

The new wire and cable plant of the Northern Electric Company, Limited, now nearing completion, occupies an area of 178,000 sq. ft. (over four acres) bounded by St. Patrick, Shearer and Richardson streets in the city of Montreal. The present plant, located at the corner of Guy and St. James streets, being entirely inadequate to cope with the increasing demand for the wire and cable products of this company, has necessitated the erection of an enormous new structure which when completed will be the largest single plant in America for the exclusive manufacture of wires and cables.

E. G. M. Cape & Company, Limited, have the general contract for the building. The foundations for walls and columns are composed of plain and reinforced concrete. In the main building and some of the one-storey portions, the columns rest on Raymond concrete piles, of which 4,,000 have been driven with an average length of 12 ft. On each group of piles rests a reinforced concrete cap on which bases for the building columns are placed.

The 6,500 tons of structural steel required for the superstructure were supplied and erected by the Dominion Bridge Company. Bethlehem H columns, girders and beams were used almost exclusively throughout.

The most modern fireproof construction has been specified throughout the entire building, all interior columns being incased in 4¾ inches of hollow terra cotta and beams in 2⅜ inches. The floors are composed of hollow terra cotta segmental arches with a span of 6 ft. 8 in., and are suitable for a live load of 288 lbs. on the second to seventh floors and 150 lbs. on the eighth floors.

A stone concrete fill is poured over the arches, in which wooden sleepers are embedded, and the underflooring is nailed to these sleepers, and over this, the final maple flooring is laid at right angles. The National Fireproofing Company supplied all the fireproofing terra cotta, amounting to 11,000 tons.

The walls are built of Laprairie plastic brick, seven millions being used. All the lintels in the courts and on the street sides, together with the architectural ornaments and copings on the street sides were supplied by the Atlantic Terra Cotta Company, of Tottenville.

The main buildings, shaped like the letter "E," have two main courts, which serve to provide ample lighting facilities for the 500,000 sq. ft. (over 12 acres) of floor space from the interior as well as the exposed sides on the streets. These courts have sloping roofs of book tile with large skylights. The G. T. R. and C. P. R. railway tracks run into one court which has large platforms for shipping and receiving purposes. Each track is provided with a 150-ton Canadian Fairbanks track scale.

There are four travelling electric cranes, one 50-ton, one 20-ton, one 20-ton with 5-ton auxiliary hoist and one 10-ton, all made by the Case Crane Company. The 50-ton crane will be used for handling reels of armored cable, the 20-ton for the lead covering department, the 20-ton with 5-ton auxiliary for the turbine room, and the 10-ton for the impregnating tank room. The two 20-ton cranes are arranged so that they can pass material to the 50-ton, which will convey it over the railway tracks or vice versa.

Fire walls with automatic steel fire doors on both sides, divide the building into various sections. Each section has a fire and smoke-proof stair tower with iron stairs at both ends, thus providing ample and safe means of exit in case of fire on any floor. The fire doors for the whole building were supplied by the Architectural Bronze & Iron Works and the iron stairs by John Watson & Son, Limited. All windows throughout the building have steel frames with wire glass. Pivoted sections of these windows can be opened with operating chains equipped with fusible links, thus making them self-closing in case of fire. The 95,000 sq. ft. of steel sash required for the factory was supplied by the Trussed Concrete Steel Company and the casement sash for the offices by Henry Hope & Sons, Limited.

All drains and underground sprinkler mains are being installed by James Ballantyne. The sprinkler and fire hose systems above the first floor level are supplied by H. G. Vogel Company (Canada) Limited, and consist of 6,000 sprinkler heads and fire hose located at convenient points in the building. These systems are supplied with water from the city mains, steamer connections on the street and a 1,500 gallon Worthington Underwriters' fire pump which is connected to a 100,000 gallon concrete reservoir and the canal.

Five 6,000 and one 15,000 lb. freight elevator with a travel of 100 ft. and 25 ft. per minute respectively, will be used to handle the transfer of material for manufacturing, and two high speed passenger elevators travelling at 350 ft. per minute, will be used to serve the general offices of the company which are situated on the eighth floor of the building. They are being supplied by the Otis-Fensom Elevator Company.

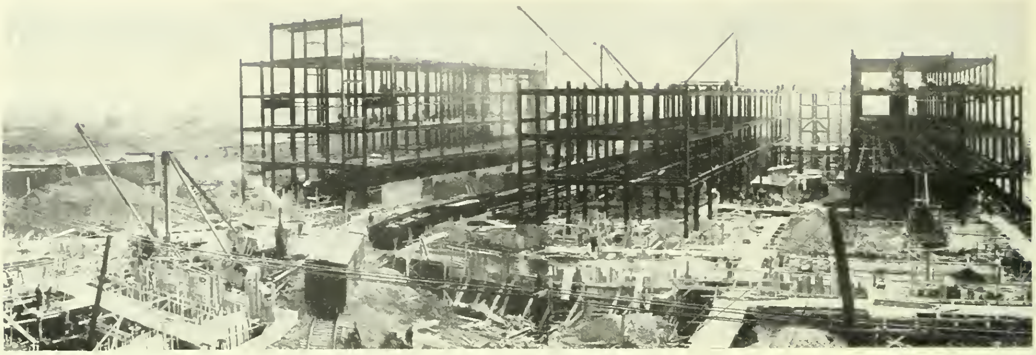
Boiler and Power House -Northern Electric Co.

This floor has no columns, the roof being supported by steel trusses with large skylights. The absence of columns afford splendid facilities for the laying out of offices to suit the requirements.

A unique point in the design of the building is the storage space secured on the roof of one section by means of paving bricks. This roof is served by means of one of the 6,000 lb. freight elevators.

Large intake pipes from the canal supply the reservoir and the water used for condensing purposes. An automobile garage and a wagon court with platforms facing St. Patrick street are so arranged that the material can be readily loaded for city delivery without having to cross the railroad tracks.

The building will be heated by a forced circulation hot water heating system. Exhaust steam from one of the main turbines will be passed through closed heaters. The water will be circulated by means of a 4,000 gallon Alberger single stage volute pump directly connected to a Alberger Curtis steam turbine. The vapors and condensate from the exhaust steam will be carried from the heaters by means of an



Steel construction work—New plant of Northern Electric Company, Limited

Edwards air pump with a tail pump. This makes a very flexible system to suit the changes in the outside temperature, as the vacuum can be increased in warm weather, thereby creating a lower temperature of the exhaust steam and decreasing the amount of steam required by the turbine as the vacuum increases. In extreme cold weather the turbine can exhaust into the heater at atmospheric pressure and thus increase the quantity and temperature of the steam. When running two turbo-generator units in parallel, one turbine can run condensing, while the other exhausts into the heating system and its load can be varied to suit the amount of steam required for heating purposes. The power plant equipment for this heating system is in duplicate, either one of the units being large enough to take care of the whole system. The enclosed heaters mentioned above were built by John McDougall Caledonian Iron Works, Limited.

The water required for the house service system and for manufacturing purposes will be pumped from the 42-in. intake pipe mentioned above by means of Deane motor driven single acting helical geared triplex pumps, also supplied by John McDougall Caledonian Iron Works Company. The Canadian Ingersoll Rand are supplying two steam driven air compressors, which have a combined capacity of 1200 cu. ft. per minute.

The Power Plant

The power plant is of the most modern design. Coal can be stored in large quantities and will be transferred to the storage bins over the front of the boiler by means of a Telpher car and clam shell bucket. Ash handling equipment takes the ashes directly from ash shutes under the boilers and delivers them into ash storage bins which in turn deliver them into railroad cars or carts for disposal. Ashes can also be handled by means of small cars on an industrial railway running in the basement of the boiler room. The Telpher car will raise the body of each of these cars off the truck, through a hatchway in the main boiler room floor, and will carry them over to the ash storage bin. This method of ash handling will only be used when it is necessary to overhaul and repair the regular ash handling equipment.

A 225-foot chimney built by the Alphons Chimney Construction Company, serves four B. & W. boilers nominally rated at 650 horse power, but which will be forced to deliver 1,000 horse power when necessary. These boilers are fitted with B. & W. chain grate stokers and superheaters. The exhaust steam and condensate from the heaters, turbines, condensers, and steam-driven auxiliaries is brought to a Warren and Webster feed water heater, which is capable of raising 107,000 lbs. of water per hour to 210 deg. From this heater the water is returned to the boilers by means of two Weir boiler feed pumps, each with a capacity of 6,000 Imperial gallons per hour. General Electric Curtis horizontal turbines form the motive power for the generators and are placed on structural steel stands directly over the Alberger condensers, thus insuring a high vacuum. The condensers are located over two 42-in. pipes leading to the canal. From one of these pipes the water is drawn by a turbo-volute turbine-driven pump, and after having passed through the condenser is discharged into the other pipe. Tunnels leading from the turbine and pump room are used to run the power and lighting circuits, the flow and return pipes of the forced hot water heating system, the house service water lines and the high pressure steam lines for manufacturing purposes.

The turbine room has been laid out for two 2,000 kw., and two 1,000 kw., turbo-generators, two 460 kw. rotary convertors, and two 75 kw. turbo-driven exciters. One 1,000 kw. and one 2,000 kw. turbo-generators and two rotary convertors will be installed now. The generators are 3-phase, 60 cycles, 440 volt, star wound with neutral connection brought out to the switchboard. The exciters are 125 volts and generator voltage will be controlled by Tirrill regulator.

General view of Northern Electric plant.

Air for the ventilation of the generators will be taken from a duct in the foundations of the generators and forced through the windings and air passages by fans integral with rotors. Screens will be provided in the pent house of this duct, to exclude dust, etc.

The horse power of connected load will be approximately 550 h.p., direct current at 115 volts and 4,000 h.p. alternating current at 440 volts. For the supply of the former two 460 kv.a. rotary converters, with necessary transformers and

starting switches, will be installed, the neutral being brought out from each transformer bank for the neutral of a 115/230 volt 3-wire direct current system.

The switchboard for the control and distribution of this power will consist of a main board of twenty-five Blue Vermont marble panels on the turbine room floor. On this board will be mounted the meters for measurements of outputs of generators and loads on the feeders, also the direct current bus-bars both for exciters and direct current factory load, and control equipment for twenty-five solenoid operated feeder switches for alternating current distribution. These switches will be mounted on Monson slate panels on a mezzanine floor under the turbine room floor. The alternating current 440 volt bus-bars and generator switches will also be located here.

Generator switches will be non-automatic with bell ringing attachment and feeder switches automatic, as mentioned above. All feeders will leave the turbine room in a tunnel from which they will branch off to the various buildings in three inch fibre conduits. These fibre conduits will lead to cable pits from which risers of three-inch conduit will be carried to distributing panels. All alternating current cables will be three conductor paper insulated, leaded; direct current cables being single conductor leaded. For lighting factory area, four-light clusters, wired series parallel, will be used. As mentioned above, the neutral point of generator windings will be brought out. The lead sheath of the lighting feeder cables will be bonded to the neutral bus and lighting circuits will connect one wire to one of the three conductors, the other to the sheath giving approximately 266 volts across two lamps in series. Lighting feeder cables will lead to distributing boxes on the third floor of each section from which circuits will run to the panel boxes on the different floors. Power feeders will run to distributing boxes on the third and fifth floors from which circuits will run to power loops on each floor.

All wiring except that in general offices will be open conduit. The general offices will have outlets for fans, dictographs, annunciators and telephones, all wiring concealed in conduit.

A large number of 3-phase, 60 cycle motors will be used for direct connected, belt and group drives.

L. K. Comstock & Company have the contract for wiring the lighting and power circuits.

An artesian well is being drilled by Wallace Bell Company, Limited, and will be used for drinking water and for manufacturing purposes.

In addition to the fibre protection system, a regular watchman's service system will be installed so that the building will be patrolled at all times outside of the regular working hours.

For the convenience of watchmen and to avoid the use of oil lanterns in the plant, a certain number of electric lights will be kept burning all night to form a pilot system so that in cases of emergency the workmen in the building can easily locate the fire apparatus and also the exits.

The following features in connection with the building are of interest:—The total excavation amounts to some 50,000 cu. yds. Over 14,000 cu. yds. of concrete have been used for foundations. 1,500 carloads of building material have been received up to the present time. 100,000 sq. ft. of glazing has been used and approximately 100,000 sq. ft. of hot water radiation service will be required.

The work has been carried on under the direct supervision of Mr. E. F. Sise, President of the Northern Electric Company, Limited; Mr. J. D. Hathaway, General Superintendent; Mr. J. S. Cameron, Plant Engineer, and Mr. W. J. Carmichael, Architect.

Personals

Mr. D. W. Houston for some time acting superintendent of the municipal street railway department of the city of Regina has been appointed superintendent.

Mr. T. R. Fulton has resigned his position as local manager of the Toronto office of the Eugene F. Phillips Electrical Works. The office will be temporarily in charge of Mr. G. R. Blair, Mr. Fulton's assistant.

Mr. H. H. Scott the newly elected president of the National Electric Light Association is a Canadian, born in Orillia, Ont., September 14, 1874. Mr. Scott is general manager of the Doherty Operating Company which operates 104 public utility plants in various parts of the United States. He is also a director in a number of the corporations owned and controlled by Henry L. Doherty & Company.

Mr. Guilford M. Stuart.

Mr. Guilford M. Stuart, president of Stuart-Howland Company, has been elected president of the Canadian Club of Boston, an evidence that while for business reasons he is a citizen of the United States he is still heartily interested in and thoroughly in touch with the land of his birth. Mr. Stuart was born and spent his early life on a farm near Albert, N.B., and received his education at the public schools in that section. In his early twenties deciding to leave the farm he graduated from the St. John Business College and entered the employ of R. P. McGivern of that city as bookkeeper and confidential clerk. After five years he removed to Boston and started in on his own account to market woodworking machinery. In this connection he travelled the eastern half of the United States for five years and later for three years in Europe, returning to Boston in 1898 where he entered the electrical supply business as treasurer of the Anchor Electric Company. In 1900, with Chas. F. Howland and Arthur Howland he formed the Stuart-Howland Company, of Boston, taking the offices of treasurer and general manager. Later Mr. Stuart acquired the interests of the Howlands and is now president, treasurer and practically sole owner of this company which, owing to the energy and business acumen displayed by its manager throughout is now one of the best and most active electrical supply jobbing houses in the United States. Mr. Stuart is also treasurer and practically sole owner of the Standard Magnet Wire Company, of Boston. If he displays as much energy in the affairs of the Canadian Club as he has done in his private business enterprise a marked growth in the membership, activity and usefulness of this club may be expected.

A Bright Outlook

At this time of business depression it is well to note figures just issued by the Statistical Department of the Dominion Government which state that Canada's total land area is 1,401,316,415 acres, of which only 7.18 per cent, or 109,770,085 acres are occupied as farm lands. The extent of good farm property is given as 440,951,000 acres so that our grain products, immense as they are already, are less than a quarter of what we are capable of producing.

Ground was broken for a new factory for the Holtzer-Cabot Electric Company on Amory Street, Roxbury, Mass., on May 21.

Electrical Engineering in the Industrial Field

The Engineer in Relation to Client, Contractor and Architect

By F. R. Ewart

The time is arriving in Canada for more systematic application of engineering methods to electrical work in the industrial and commercial field. The amount being spent annually on interior installations is increasing rapidly. More and more establishments are relying on electricity for light and power. More complete and costly systems are everywhere being installed. Expert handling of such work, therefore, is becoming a necessity for the benefit of each business in particular and for the economic good of the country as a whole.

In the past, the business man has had nobody to turn to for help in such matters. In many cases he has had to ask some contractor "How much to wire my building?" If the sum named has sounded reasonable, he has given orders to proceed. Since neither party to the agreement has any very definite idea of the requirements, it is not remarkable that the result is often very unsatisfactory. The contractor is probably doing his honest best, but cannot, for many reasons, plan everything carefully before starting the work. This same method might have worked out all right twenty years ago, when the installation was rudimentary and the cost trifling. Under modern conditions the work is frequently complex and the cost considerable. The same business man would not ask a building contractor "How much to build me a factory?" He would employ an architect to draw plans and specifications for his building and see that these were satisfactory before starting any work at all. In other words, he would be anxious to know what he was getting before going ahead. Why should he not exercise the same caution in regard to his electrical installation? It is true that the latter does not involve so much money as the building, but poor or ineffective work may prove as great a handicap in the conduct of his business in one case as in the other. The Pilgrim Fathers, no doubt, got on fairly well without the aid of the architect, but it did not take long for the development of the country to create a demand for his services. Today he is considered necessary for the erection of anything more pretentious than a wood-shed. Should the business man, then, content himself with the crude methods of the pioneer days of electrical work?

The Engineer and the Business Man

Until recently, the electrical engineer of this country has paid little attention to the business man's need of him. He has considered his only sphere of activity to be in the handling of large projects such as power developments, central station work or the manufacture of electrical apparatus. As the engineer has not offered himself to the business man, the latter has not been able to call on him. Some of the best engineers in the United States find a good part of their practice with business concerns. The time should, then, be ripe for the Canadian electrical engineer to advance his practice more definitely into the industrial field. It is the chief object of this article to roughly outline the nature of the practice of industrial electrical engineering on a consulting basis and also to show some aspects of the relationships between engineer, client, contractor and architect.

Let us suppose that a manufacturer engages the engineer to handle the complete electrical installation in a new factory. The engineer is given a set of building plans and immediately wants accurate information regarding what machines, equipment, etc., are going into the building and just where each thing is to be located. In a few rare cases the client has given this question close study and can supply the information. In most cases, however, he fails to see that this has anything to do with the engineer's work and asks him to go ahead and let the lay-out problem take care of itself afterwards. Right there the engineer must carefully explain that he is not proposing to scatter so many lights and power mains through the building and trust to Providence that they may meet the requirements. He shows, for example, how different kinds of work need different lighting and in general that every little detail of the electrical equipment should have an exact relation to the duty to be performed. Very often the question can only be solved by the engineer making up complete equipment layout plans as the first essential, before approaching his work proper. On this account he must frequently become an efficiency engineer and study the factory process of his client. He must lay out the whole factory from the standpoint of space, economy and efficiency of operation and produce a result that will satisy the manufacturer.

Illumination Not Guess Work

With this done, the engineer may next proceed with his scheme of illumination. This is not a matter of guess work. Each process or machine may have to be separately treated, and the best method of obtaining the necessary results determined scientifically. When he is through he knows exactly why he located each outlet where he did, just what equipment he intends using on each outlet, and just what results will be obtained in every case. It is no longer a question of experimenting with various equipments under various conditions to find anything that will be at all passable.

The next step is to connect up these outlets in proper circuit groups and feed these circuits from suitable distribution points. In this regard proper attention must be given to economy of materials, adjustment of capacity and provision of suitable control. Proper feeders must then be provided to supply these various points. It will be noted that the sequence is in opposite order to the flow of power, that is, beginning at the various machines, etc., and working steadily back to the power source. So often a mistake is made by starting with the service and feeders before determining the requirements they must meet. While a lay-out determined by the method described above is intended to fill exact requirements in an exact way, it will frequently be found that many features can be so planned so as to provide a reasonable adaptability in case of changing conditions in the future.

When all the work described above has been worked up into a complete plan, it is time to write specifications. The plan will indicate clearly the nature and location of everything, but cannot show in detail the exact nature and quality of each item. It should be the main purpose of the specifications to supplement the plan in this regard. The chief purpose of specifications is to cover thoroughly the sizes and qualities of the various materials to be used. Any special points regarding the manner of installing these materials should then be covered. So often specifications are found to consist largely of rules for the way in which various standard materials are to be made. Frequently these are nothing more than quotations from the N. E. Code or standard manufacturers' specifications. If the requirement is laid down, that all work must comply with the Underwriters' rules, it will not be necessary to describe how a steel box

shall be built or how the insulation of a standard cable shall be made up. The engineer can confine himself entirely to the sizes, capacities and grades and in so doing will make his specifications much more explicit.

When plans and specifications are completed, a contract can be let and the work started. From then on, the engineer will have to regularly supervise the work as it proceeds. He will see that the work is done in strict accordance with his plans and specifications. He will also have to decide many minor details which could not have been originally foreseen. He may have to revise some feature due to changes in the architect's plans or needs of the client. Under such circumstances he will make the necessary adjustment with the contractor for extras or deductions, sometimes a delicate matter.

Purchase of Equipment

At the same time that the contract work is proceeding, he may also assume other important duties on behalf of the client. Probably the most important of these is the choice and purchase of equipment such as motors, elevators, etc. He must give careful consideration to the requirements, particularly in regard to capacities and mode of operation. This will often involve the "Safety First" problem, which is becoming so vital with the adoption of a Workman's Compensation Act. When he has decided what is required and proceeds to purchase he will be guided by two considerations,—quality and price. He will not necessarily buy the very best, no matter how high the price. Neither will he buy the cheapest regardless of how poor the quality. He wants a product that he can feel sure will thoroughly meet the requirements, and then he wants that product at the closest price he can get. Since the engineer is regularly in the market and is a good judge of values, he should be able to buy closer than the casual purchaser and in most cases he does.

While there are many other minor activities involved in the engineer's work, the foregoing should prove sufficient to give an insight into engineering practice applied in this direction. The natural question arises, "How does such work affect those most concerned, the client, the contractor and the architect?" "What is the relation of the engineer to these interests?" The client may realize some very strong advantages in the employment of the engineer. The time of the president or manager of a large concern is naturally valuable. The amount of time he will spend in working out the details of a more or less unfamiliar problem may be worth many times the engineer's fees. He can save himself a large part of the worry, which has a baneful influence in the upsetting of his regular work. In most cases he will make a good monetary saving, since the engineer will protect him from unnecessary expenditures and procure the real essentials at minimum cost. Best of all he will have in the end an installation thoroughly suited to his work.

All the dealings between engineer and client must be in the open. To get the best results, the client must take the engineer into his confidence, show him his factory methods clearly and give him a real insight into the workings of his particular business. The engineer, on the other hand, must keep the client advised of what he is doing and his reasons for doing so. He cannot afford, for instance, to accept commissions from dealers or manufacturers, unless the client agrees and the amount is credited towards the fees. In matter of this nature there is no better guide than the Code of Ethics of the A. I. E. E. The engineer will often find, too, that it is a difficult matter to convince the client of the correctness of his methods along some lines. In such cases, he must fight hard to win his point. If the work is not of the best in the end the fact that he has been over-ruled in many points will help the engineer's reputation very little. The responsibility is his, and the task of convincing his client is part of it.

The contractor may benefit quite as much as the client from the work of the engineer. In the first place, it insures fairness of competition. In tendering he knows that he is figuring on a clear-cut proposition and that every competitor will be compelled to figure on the same thing. As the requirements are laid clearly before him, he spends much less time in making up his bid than if he were uncertain on many points. The loss then in case of failure to obtain the contract is reduced to a minimum. He is also spared the necessity of doing a lot of gratis work. So often a contractor is forced to make plans and specifications of his own in order to show what he is tendering on. The expense of this is unwarranted even when successful and when he fails to land the business it means a bad loss. It also means that he is frequently shouldering the responsibility for details that should not properly be his.

The successful contractor can handle the work to much better effect than in the ordinary case. Losses of time due to uncertainty will be negligible. As the work is started and carried through as a whole, instead of working from point to point, a considerable economy of labor is generally realized. Superintendence expense will also be reduced. The contractor will not have to appear personally on the work several times every day to see than his foreman has not been compelled to suspend the work through uncertainty of the proper procedure.

It is obvious that careful engineering work will improve the calibre of the installation. The contractor can feel, therefore, that his reputation is certainly not suffering through association with a creditable job. If difficulties arise in the work and changes are required that call for extra compensation, the contractor can readily satisfy the engineer as to the justice of his claim. The client alone is often unduly suspicious and hard to handle.

Engineer and Architect

The relation of the architect to interior electrical work is a peculiar one. In the past he has had this work thrust on him, since there was no one else to handle it. In the early stages there was rarely anything more involved than ordinary house wiring. This perhaps required the services of an engineer no more than the erection of a wood-shed required the services of an architect. To-day, however, many commercial installations are important enough to be distinctly engineering propositions. Under such circumstances it is not fair to any of the interested parties for the architect to attempt to handle such work himself. If he is a first class architect he will not have been able to become a first class electrical engineer at the same time. The electrical engineer does not find that he can become proficient in architecture by studying it as a side line or hobby. One science is quite as complex as the other. It is true that some architectural firms may have enough big electrical work to employ a competent engineer themselves. But such cases are very rare exceptions. In the general case, therefore, it is not fair to the client nor to his own reputation for the architect to attempt to handle work for which he is not absolutely competent. This fact has been realized by many of the better firms, who to-day are calling on the services of electrical experts to help them out. By so doing the architect is more likely to have an electrical installation in his building that will measure up to the high quaality of his own architectural work.

Unfortunately the basis on which these relations have been built has not always been entirely satisfactory. The architect has still shouldered the responsibility toward the client, and has made the engineer answerable to himself. Frequently, too, he has been tied down by the scale of his own fees, and been forced to offer the engineer a remuneration too low to be productive of the best results. A percent-

age which may prove adequate as applied to a whole building may be entirely insufficient on a special feature. The amount of detail may require and merit much greater work in proportion to the cost.

The real solution would appear to rest on the education of the business public to deal directly with the engineer in engineering matters, thus relieving the architect of all responsibility in these matters. The architect should not resent this as an infringement of his rights. In most cases it will affect his fees very little, if at all. In any case the difference will be inconsiderable compared to the advantages. He will be relieved of the responsibility of something which is a little out of his line. He will be relieved of an amount of work which can scarcely leave more than a trifling profit on this item. And he will see an installation go into his building that will be creditable to all concerned.

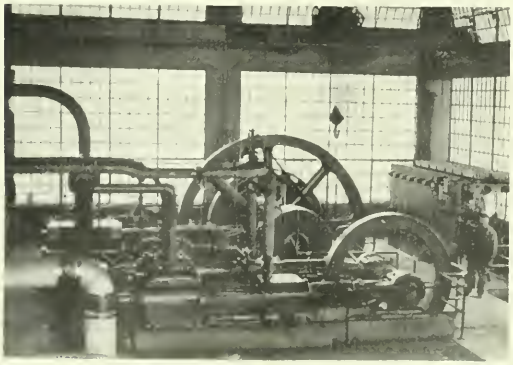
There is no insuperable obstacle to the direct dealing of both architect and engineer with the client. The point wherein the work of the one comes in contact with that of the other can easily be adjusted by a little mutual agreeability. The time and trouble taken in setting such points should be quite negligible.

The electrical equipment of most modern commercial enterprises is a question vitally affecting its success. The business man can no longer afford to allow the matter to be handled by carelessness or incompetence. He can not afford to attempt to work out his own salvation. He cannot afford to entrust the matter to anyone but an expert. He needs the engineer and needs him badly. To get the best results he must be in close personal touch with the engineer.

Isolated Plant for M. C. R. in St. Thomas

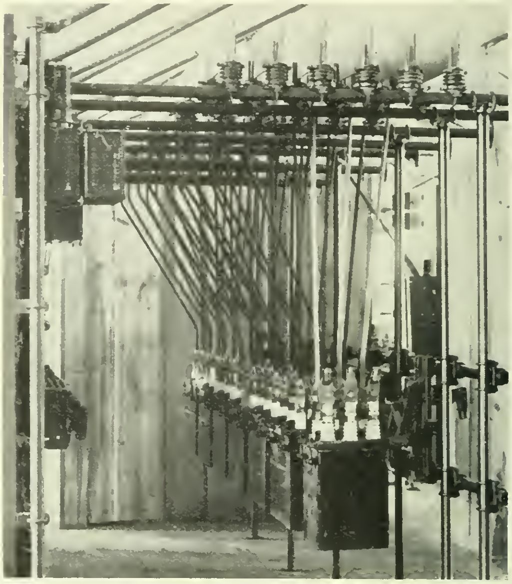
In order to prevent, if possible any interruption to the work in their shops at St. Thomas, Ont., which may result from electric disturbances of any kind on the high tension transmission line of the Hydro-electric Power Commission of Ontario, the Michigan Central Railway Company have recently added to their electrical plant a complete engine-driven electric generator unit. The electric equipment was supplied by the Canadian General Electric Company.

The engine was furnished by E. Leonard & Sons and is of their extra heavy duty type; cylinder size 24-in. x 42-in.; working pressure 150 lbs.; 100 r.p.m.; rated horse-power 500. This engine is used for supplying power for the various shop machines, cranes, etc., which are all direct connected to motors. The exhaust steam is used for heating. The engine is equipped throughout with a complete Nugent oiling system, including filter, through which the oil is passed after being used in the engine. It is then used over again, enabling the engine to operate continuously with a very small oil consumption.



Engine-generator plant of M. C. R. Co.

The generator is 375 kv.a. capacity, 100 r.p.m., 3-phase, 25-cycle with belted exciter 18½ kw., 600 r.p.m., 125 volts. The equipment in the power house also includes three single-phase transformers each 225 kv.a., 13,200/575 volts, these for obtaining the supply from the St. Thomas Commission's lines. The low voltage transformers include a 50 kv.a. unit 550/127/220 volts and one 25 kw. unit 550 127/220 volts.



Rear of Switchboard—M. C. R. Co., St. Thomas.

An item of particular interest is the switchboard which consists of nine natural black slate panels, 90-in. high, mounted on pipe supports, there being six feeder panels, one combination exciter and a.c. generator panel, one T. A. regulator panel and one combination incoming line and transformer panel. There are two sets of 575 volt bus-bars, one set being connected to the generator and the other to the 13,200 volt incoming line through a bank of transformers. All feeder circuits are equipped with double throw oil switches so that they can be operated on either set of busses. This produces a very flexible system and minimizes shop shut-downs due to either interruptions on the Hydro-electric System or to trouble with the generator.

Oil switches, bus-bars and instrument transformers are mounted on pipe framework back of the switchboard, see figure, and all apparatus is hence easily accessible. There is absolutely no crowding of apparatus so that the factor of safety is high both as regards the apparatus and the operators and yet the switchboard is compact.

The various circuits are equipped with the usual devices for this class of service except that the incoming line panel includes also a curve drawing power-factor meter and a curve drawing wattmeter. Each automatic oil switch is controlled by a time limit overload relay, thus preventing unnecessary shut-downs due to the momentary disturbances.

The Arnold Company, Chicago, were consulting engineers.

Electricity on the Ontario Farm

A few figures showing the results of two years pioneer work among the farms of South Western Ontario by the Hydro Electric Power Commission of Ontario

The employment of mechanical drive on the farm for the operation of threshing machines, ensilage cutters and elevators, circular saws, grinders, water pumps, pulpers, milking machines, butter workers, cream separators, churns, fanning mills, etc., can hardly now be considered of recent origin but the adoption and utilization of the electric motor for power purposes on Ontario farms is just at present of paramount interest.

The electric motor when compared with other types of prime mover, especially the steam tractor and explosion motor, possesses salient advantages both as regards efficiency and fire hazard, and, as a result, is worthy of the most careful consideration in connection with farm power installations. Electric energy also offers, in addition to other advantages, a simple and economical conversion into either light or heat, and is therefore particularly adapted to farm service.

The inherent advantages of the electric motor and also of individual drive are already too well known to require re counting in this article, but the results which are printed in the following pages and which have been secured after the most careful experiments and investigations, may prove of interest to those who are not already cognizant with the work the Hydro-electric Power Commission has accomplished in various parts of the rural districts of the Province of Ontario.

Demonstrations

Early in the Fall of 1912 the Commission, after extensive investigation both on this and the European continent, designed and constructed two twenty-five horse-power electric motor outfits for use in the rural districts during the threshing season. These outfits, each consisted of two Bain wagon gears upon one of which was mounted a 25 h.p., 3-phase, 220 volt, 25-cycle motor and auto starter, and upon the other three 20 kw. 2200/220/110 volt transformers, an oil switch, lightning arrester and meter. Both the motor and the transformer wagons were provided with covers and hauled from place to place by horses, the motor being operated at the various farms through a connection to the transformers and the 2200 distributing lines of the Commission.

Threshing and silo-filling were performed throughout the season with these outfits and the results secured were much better than were anticipated. However, the 25 h.p. outfits were expensive, and, although they were economical in operation, the Commission decided to experiment with a smaller outfit. Accordingly, during the early part of the Fall of 1913, a small threshing machine, ensilage cutter and 5 h.p., 3-phase, 110 volt, motor were purchased and from the actual operation of these machines additional data on threshing and silo-filling was secured. The smaller outfit and machines were found to be more nearly adapted to use on the smaller farms of Ontario, since they could be operated economically and might be purchased for a small amount. In addition, the 5 h.p. motor might be utilized during the remainder of the year for other operations on the farm.

Naturally where the smaller outfit and machines were employed the threshing and silo-filling operations extended over a slightly longer period, but on the other hand, these operations, as will be seen form a table which appears later, were accomplished at a lesser expense, especially when com pared with "contract" work.

The data secured with these outfits together with that collected at a few of the several demonstration farms, is given in the pages which follow.

General

The Hydro-electric Power Commission of Ontario is at the present time supplying approximately 150 farms with electrical energy for either power, lighting or heating purposes. The majority of these farms are located in the south-western parts of the Province in the Townships of Toronto, North Norwich, South Norwich, North Yarmouth, South Yarmouth, North Oxford, East Oxford, West Oxford, East Flamboro, East Zorra, Grantham, Ancaster, Downie, Puslinch, West Nissouri, Blandford, Waterloo, Wilmot and Westminster, and are supplied from the Niagara transmission system of the Commission with power generated at Niagara Falls.

The greater portion of these farms is located adjacent to the transmission and distributing lines of the Commission for otherwise the cost of distributing and supplying these customers with power would prove excessive, and the proposition would not therefore present economic possibilities.

The interest evidenced by the farmers and the residents of the smaller villages has greatly aided the Commission in their efforts during the past year to promote an increased use of electricity for lighting, heating and power purposes in the rural districts of Ontario. Rural distributing systems to supply farms and small villages have already been constructed or are at the present time under construction in a number of townships. Where the amount of power sold to a district is large enough to warrant supervision by the township, this business is generally handled by the township itself, otherwise the nearest town handles the work until the system has grown sufficiently to warrant the township taking charge. This arrangement to date has proved very satisfactory since it permits of the establishment of a number of demonstration farms in various parts of the province, and made it possible for the rest of the township to profit by graphic examples of the many uses of electric power on the farm. In addition, much useful information has also been collected on these farms and this has been utilized in preparing recommendations as to the most suitable installations for the average farm under various conditions and also in arriving at the proper system of charge for the different kinds of service.

Classes of Service

There are three classes of consumers in the rural district. First, the consumer who merely wants power for illuminating purposes; second, the consumer who wants power for lighting purposes and motors with a rating up to and including 5 h.p., and third, the consumer who wants power for lighting, small motors, and a large 20 h.p. outfit, the latter to be used for such work as threshing and silo-filling.

The first class of consumer—in fact, all consumers who have motors rated at less than 2 h.p.—are supplied with single-phase energy at 110 volts pressure. The second class of consumer, i.e., those employing motors rated at 5 h.p., are supplied with three-phase energy at 110 volts pressure, while the third class of consumer, generally consisting of a syndicate comprising seven or eight farmers who have purchased a portable 20 h.p. motor and transformer outfit (similar to those employed by the Commission during the Fall of 1912) for use in common, to accomplish their threshing and silo-filling, are supplied with three-phase energy at 2200 volts

pressure supplied directly from the distributing lines of the Commission.

Service Charges

The Hydro-electric Power Commission, as has been previously stated, is endeavoring by every possible means to supply the farms of Ontario with cheap electrical power. The actual cost of supplying this energy, of course, depends directly upon the number of consumers per mile as well as the aggregate load of the district, since the service charges collected from these consumers are employed to pay the interest and maintenance charges on the distributing lines. These service charges amount to about $10.00 per mile of line per month, so that where there is an average of three consumers per mile, each is required to pay a service charge of $3.00 or $3.50 per month, while with an average of five consumers per mile the charge is found to be about $2.00 per month per service.

Procedure for Power Supply

The method of procedure to be followed by those farmers desiring a supply of electric power in districts not already served is clearly outlined in "The Power Commission Act of 1911 (1 George V. Chap. 14)." To those not already familiar with this legislation the following resume may prove of interest.

The farmers or ratepayers of the township or district desiring to purchase electric power from the Commission are first required to canvas their district and ascertain the probable amount of power which can be sold in the district. The information thus obtained is then forwarded together with a petition for a supply of power to the township council, who, in turn, apply to the Hydro-electric Power Commission for an estimate on the maximum cost of power to be supplied by the Commission. Estimates are submitted by the Commission after the most careful investigation and only then if the proposition appears feasible. The township is then required to secure contracts with the various ratepayers or farmers petitioning and later, sign a contract with the Commission for a definite amount of power.

Distributing System

All rural distributing systems are constructed by the Commission and generally supplied with power from the substation or stations located in the nearest town or towns in the vicinity. In case there are no adjacent stations of this sort but where the 13,200 volt lines pass through the township, 13,200/2,200 volt pole type transformer stations are usually built.

The power is transmitted at either 2,200 volts or 4,000 volts, three-phase. The conductors consist of No. 6 hard drawn copper wire which are carried on 5,000 volt insulators mounted on 4 pin arms, the latter erected on 25 ft. to 30 ft. poles. All poles are bought in accordance with standard specifications prepared by the Commission. The primary circuit or circuits, as the case may be, are carried on either one or two 4-pin arms. The secondary circuits being carried on Peirce brackets erected at lower points on the poles. The lines are designed for initial operation at 2,200 volts, delta. When the distance of transmission is increased or the capacity of the line is found to be insufficient for economic operation, the system may then be changed over to operate at 4,000 volts Y by the addition of a No. 6 copper clad steel wire neutral carried either on the fourth pin of the cross arm or erected at the tops of the poles on ground wire clamps and the necessary changes made in the transformer connections. The neutral wire is permanently grounded at frequent intervals. The estimated cost for this type of construction is about $1,000 per mile.

Each farmer as a rule is supplied from a separate transformer, except in cases where two farms are situated directly opposite each other on either side of the road. The power is sold, depending upon the choice of the consumer, either at a meter rate (kilowatt-hour) or on a flat rate contract.

The farmer is required to provide all poles, wires and other equipment located on his premises. The township supplies only the connection to the first pole on the property of the consumer and also the meter when one is required.

The costs of wiring the different buildings of the farm vary from $1.25 to $2.00 per outlet for open work and from $2.50 to $3.50 per outlet for concealed work.

Wiring Recommendations

The Commission is at present engaged in preparing recommendations, as to the most suitable installations which will give the maximum amount of safety for the minimum outlay in connection with the wiring of barns and farmhouses, special precautions being recommended in the wiring of barns and outbuildings in order to secure reduced fire hazard.

Electrical Installation

The usual electrical installation recommended for a 250-acre farm consists of a complete lighting system employing 25 to 40 watt metal filament lamps in the house, barn, cow stable, etc., two 100 watt metal filament lamps in the farm yard and one 100 watt metal filament lamp outside the entrance to the farm on the road. A 5 h.p. motor permanently installed in a suitable location in the barn so that a milking machine, grinder, and in some cases, a water pump, may be easily operated from a single counter shaft, is further recommended for power purposes. Frequently it is found necessary to install a smaller motor for operating the water pump or a cream separator and churn in the milk house. Another appliance recommended is a water heater which may be installed in the milk house and comprises a 20-gallon can insulated to reduce heat losses and equipped with an electric heater. The heating unit consists of a 600 watt bulb designed to raise the temperature of the water in the can to boiling point in a few hours. This appliance provides a sufficient supply of boiling water with which to wash out the milk cans at all times.

The Commission has also made careful investigation and secured considerable data in connection with the power required to thresh various kinds of grain and fill silos. Outfits requiring from 5 to 20 h.p. for their operation are now recommended for use on those farms situated adjacent to the 2,200 volt distributing lines.

Rates

The rates charged the rural customers for power at the present time consist of a service charge and either a flat horse-power rate or a kw.h. rate per month, the former charge being based on the connected load and the latter being determined by meter. These rates, of course, are influenced more or less by several considerations and since the consumer is generally one who is unfamiliar with the uses and measurements of electric power, it is desirable that the rate be one that can be readily understood. On the other hand, the load factor varies considerably in the different townships, and it is therefore almost impossible to secure any base characteristics upon which to work.

The service charges in all cases are required to cover the annual interest charges on the capital invested in the line as well as the maintenance costs. These may therefore be easily determined. On the other hand a careful study of the load-factor of the rural load is necessary in deciding upon the power rates. The service charges up to the present range from $1.50 to $3.50 per month. The power rates at a flat rate per month range from $20 to $50 per year per h.p., or at a kilowatt-hour rate of from 4c to 7c per month which is fre-

quently subject to a 10 per cent discount for prompt payment.

The following table gives the rates at present charged in the various townships.

Table 1.—Rural Power Rates

Name of Township	Fixed Service Charge per month	Meter Rate per Kw-hr. per month	Alternative Flat Rate per h.p. per year
Toronto	$2.00	......	$36.00
West Oxford	3.00	†4½c	30.00
Waterloo	2.00	†5c	30.00
North Norwich	2.00	4c	36.00
North Yarmouth	3.00	......	35.00
South Yarmouth	2.00	......	36.00
North Oxford	2.00	......	36.00
Downie	2.00	5c	30.00
Grantham	2.00	†4½c	22.00
Wilmot	1.00 per h.p.	Power 5.4. 3.4. 0.4c	.....
South Norwich	2.00	......	36.00
East Oxford	2.00-3.00	......	36.00
East Zorra	1.00-3.00	†5c	.....
Westminster	2.00-3.00	......	40.00
West Oxford (Extension South of Beachville)	2.50	5c	30.00
Ancaster	2.00	5c	30.00
Puslinch	2.00-3.00	......	24.00
West Nissouri	2.00-3.00	5c	40.00

†10 per cent. discount for prompt payment.

From the above table it will be seen that the rural distributing lines serve a number of farms in the various townships. In addition to these, they also serve the Villages of Clarkson, Cooksville, Dixie, St. Agatha, Petersburg, Sebringville and Breslau.

Load-Factor

During the past year a careful study has been made of the load-factors in the rural districts and it was found that these varied considerably in the different townships. The diversity is undoubtedly due in a large part to the temperaments of the consumers and the periods at which they elect to operate their equipment. Some of the more ambitious start their work at 5 or 5.30 o'clock in the morning, while many others take things easier and do not do their milking until between 7 and 8 o'clock. The milking and separating are approximately the only operations which must be performed at a stated time each day and even though the times assigned for these duties vary on the different farms, these variations seldom exceed an hour in time and are therefore to be expected. The milking period, especially in the dairy sections, is practically the prevailing factor in establishing the peak loads for sections. On the other class of farms it is practically impossible to impose restrictions with farm work which would improve the load-factors as has been done on the so-called demonstration farms where the grinding is done in the afternoon and the pumping at some other opportune time during the day to secure the proper diversity factor.

The following table gives in detail the results with respect to load-factor secured on seven different farms in West Oxford Township. These farms are served from Ingersoll.

Table II —Load-Factor

Record of Power Consumption

Farmer	Amount of Contract	Use	Amount Paid	Kw-hr. for 1 year	Load Factor 5650 hr.	Load Factor 8760 hr.
J. Prouse	2 h.p.	Light & Power	$58.53	363 367 —— 730	20%	51%
W. Bowman	2 h.p.	Light & Power	Minimum $50.00	226 226 —— 452	15.8	4.3
W. O. Edwards	1 h.p.	Light	Minimum $25.00	169	6.2	2.5
D. W. Clarke	2 h.p.	Light & Power	$64.45	206 343 —— 549	10	4.2
R. E. Edwards	1 h.p.	Light	Minimum $25.00	243	8.9	3.7
K. S. Mcmulkin	1 h.p.	Light	Minimum $25.00	122	4.45	1.85
J. Lick	1 h.p.	Light	Minimum $50 00	210	7.7	3.2

Cost of Operations

The average costs for the various operations which were secured on four of the Demonstration Farms are given below, also data in connection with the costs of threshing and silo-filling, secured during the Fall of 1912 with the 25 h.p. outfit and during the Fall of 1913 with the 5 h.p. outfit.

Table III.

Raymond & Son, North Oxford Township, Oct. 22nd, 1912, to Oct. 22nd, 1913.

Operation or Appliance	Detail of Work	% of Total Kw-hr.	Cost $ c	Unit Cost	Notes
Grinding	500 bush. of oats	1.4	1.32	.26c per bush.	
Milking	680 times (Max. 30 cows) (Min. 14 cows)	28	26.93	.18c per cow per milking	
Fanning Mill	10 hours	.1	.11	.91c per hour	
Pulping Roots	30 hours	.7	.70	.233c per hour	
Cutting dry corn	60 hours	1	.95	.135c per day	
Heating water	325 times	3.7	3.52	.432c per gal.	
Sawing wood (drag saw)	20 hours	.4	.35	1.75c per hour	
Air heater	2,080 hours	35.5	33.86	1.62c per hour	
Toaster	91 times	.2	.16	.176c per time	
Electric iron	84 hours	.8	.74	.88c per hour	
Washing machine	84 hours	1.2	1.18	1.42c per hour	
Lighting		27	25.84	1.84c per kw.h.	
Threshing			.....	....	Steam
Silo-filling	16 ft. x 42 ft. silo, 211 tons (Estimated)	....	6 96	3.3c per ton	Extra over contract

Table IV—Record of Power Consumption

Township	Farmer	Contract	Service Charge per Annum	Power Charge per Annum	Total Cost per Annum	Kw-hr. per Annum	Load Factor 5650 hr.	Load Factor 8760 hr.	Average Cost per Kw-hr. S. C. and Pr.	Average Cost per Kw-hr. Power Only
W. Oxford	Raymond	2 h.p.	$24.00	$36.00	$ 96.00	5435	99.2%	41.3%	1.76c	1.32c
S. Yarmouth	Anderson	2 h.p.	24.00	36.00	96.00	2075	38.5	15.8	4.62	3.48
N. Yarmouth	Cohoon	2 h.p.	36.00	35.00	106.00	5559	101.1	42.2	1.91	1.38
N. Yarmouth	Penhale	2 h.p.	36.00	35.00	106.00	4651	85	35.4	2.28	1.5
W. Oxford	Innes	2 h.p.	36.00	30.00	96.00	4803	88	36.6	1.98	1.24
W. Oxford	Karn	2 h.p.	36.00	30.00	96.00	4927	90	37.4	1.93	1.22

Table V.

R. A. Penhale, North Yarmouth Township, March 16th to Oct. 18th, 1913

Operation or appliance	Detail of Work	% of Total Kw-hr.	Cost	Uni Cost	Notes
			$ c		
Pumping water	4 hr. per day (6,125 bbl.)	28.3	17.75	.11c per bbl.	
Milking	421 times—30 cows	23.7	14.98	.12c per cow per milking	
Separating cream while pumping	316 times	8.2	5.20	1.1c per hour	
Heating water	2,420 gals.	29	18.35	.7c per gal.	
Lighting		10.8	6.74	2.74 per kw.h.	
Sawing wood Threshing Silo-filling		....	....	....	By his steam engine.

Table VI.

Alex. Anderson, South Yarmouth Township, Dec. 13th, 1912, to Nov. 13th, 1913.

Operation or Appliance	Detail of Work	% of Total Kw-hr.	Cost	Unit Cost	Notes
			$ c		
Grinding	2,800 bush. oats and wheat, mixed	45	39.60	1.41c per bush.	
Milking	By machine, while testing it 14 times	2.7	2.38	Testing Machine	
Pumping	Using Jerker just put in	.9	.79	....	Windmill mostly Jerker, just put in
Heating water	2,724 gallons	19.7	17.34	.63c per gal.	
Electric iron	120 hours	2.9	2.55	2.1c per hour	
Lighting		28	24.63	4.62c per kw.h.	
Sawing wood	8 hr.—25 cords stove wood	.8	.71	.27c per cord stove wood	
Threshing and silo-filling		....	..	....	By steam this year

Table VII.

Ezekiel Cohoon, North Yarmouth Township, Mar. 18th to Oct. 18th, 1913.

Operation or Appliance	Detail of Work	% of Total Kw-hr.	Cost	Unit Cost	Notes
Milking	30 cows, 224 times	11.7	7.37	.11c per cow per milking	
Heating water	3,000 gallons	37.6	23.69	.8c per gal.	
Separating cream	60 hours	1.4	0.88	1.45c per hour	
Electric iron	16 hours	.3	0.20	1.25c per hour	
Pumping	856 hours	26.4	16.56	2c per hour	
Lighting		22.6	14.25	2.15c per kw.h.	
Silo-filling Threshing		....	.....	....	By steam engine

Table VIII —Threshing Data

Farmer	Township	Date	Outfit	Grain	Average h.p.	Quantity in bush.	Total Kw. h.	Total cost at 3c. per Kw.h.	Cost per bush.
John Rowse	W. Oxford	10/13	25 h.p.	Wheat	27.2	265	87	2.61	.98
John Rowse	W. Oxford	10/13	25 h.p.	Oats	19.6	1179	165	4.95	.42
Wm. Bowman, Jr.	Dereham	10/13	25 h.p.	Oats	22.2	1190	141	4.23	.36
Geo. Raymond	S. Oxford	10/13	25 h.p.	Oats	24.5	1140	203	6.09	.53
Jas. Innes	W. Oxford	10/13	25 h.p.	Wheat	24.3	476	93	2.79	.58
B. C. Edward	Dereham	10/14	5 h.p.	Wheat	4.8	375	7	.21	.57
B. C. Edward	Dereham	10/14	5 h.p.	Oats	4.8	368	25	.75	.2
W. C. Edwards	Dereham	10/14	5 h.p.	Oats	4.6	290	17	.51	.17
J. C. Karn	W. Oxford	10/14	5 h.p.	Oats	4.5	50	2.9	.09	.17

Table IX.—Silo-Filling Data

Farmer	Township	Date	Outfit	Average h.p.	Quantity in tons	Total Kw-hr.	Kw-hr. per ft. ton	Total cost at 3c. per Kw-hr.	Cost per ton
John Leigh	W. Oxford	10/13	25 h.p.	25.9	108	215	.060°	6.45	5.9
Wm. Bowman, Jr.	Dereham	10/13	25 h.p.	22.4	175	336	.051°	10.07	5.8
Jas. Fordon	N. Oxford	10/13	25 h.p.	25.5	125	197	.042°	5.92	4.7
S. J. Prowse	Dereham	10/13	25 h.p.	19.6	189	392	.055°	11.77	6.2
B. C. Edward	Dereham	9/14	5 h.p.	7.2	72	116	.050°	3.48	4.8
W. C. Edwards	Dereham	10/14	5 h.p.	7.2	96	147	.048	4.41	4.6
Geo. Raymond	N. Oxford	10/14	5 h.p.	4.9	211	232	.029†	6.96	3.2
D. W. Clarke	W. Oxford	9/14	5 h.p.	5	100	48	.023†	1.44	1.4

°Blower type of ensilage cutter.
†Carrier type of ensilage cutter.

The Development of Our Water Powers

And the Effect on the Progress of Canada

By L. A. Herdt, D.Sc., F.R.S.C.

It will be my aim in the short time at my disposal this evening to review the work on this Continent by electrical and hydraulic engineers in the development of one of our greatest natural resources—water powers—which development effects a conservation of the other natural resources of the country.

The development of water power effects a conservation of the fuel supply of the country. Electrical energy can be produced indirectly from the consumption of coal, oil, natural gas and other fuels, but electrical energy so produced is at the expense of the production of large quantities of wasted energy in the form of heat, and nature's store of potential energy in these fuels is prodigally wasted. It is a good and economical steam plant which is able to utilize ten per cent of the energy of the fuel; the rest is wasted. The hydro-electric plant is capable of utilizing as much as seventy per cent of the energy of a waterfall and thus the use of hydro-electric power is a factor helping to conserve the fuel supply for future generations. The supply of the fuels is not inexhaustible and much concern has been felt at the prospect of partial or total exhaustion of the coal deposits. The generation of electrical energy by water power does not deplete the source of supply. Water power is, perhaps, unique amongst natural resources—it is not diminished by use, nor is it conserved by non-use. Coal, which is not used to-day remains to be used hereafter, but the water has passed to the sea. From this standpoint the importance of placing these inexhaustible stores of energy at the service of man is obvious and the systematic and scientific development of water powers may be well considered a work of true conservation, and therefore a work of national importance. This country which has been abundantly blessed with this "white coal" or perhaps I may call it never failing run of oil, is intimately concerned that hydro-electric works be well conserved and intelligently executed.

It has been estimated that to operate the individual enterprises and public utilities of the United States and Canada, excluding steam railways and vessels, that not less than 30,000,000 horse-power is required. In 1913 it was estimated that over 7,000,000 h.p. 12 hours a day was generated from water power in the United States and Canada. This leaves 23,000,000 h.p. 12 hours a day generated from fuel—mainly coal. Assuming that under average conditions one horse-power-hour can be produced in a steam plant from three pounds of coal, this 7,000,000 h.p. represents a saving of 33,000,000 tons of coal per year.

In 1911 the total amount of bituminous coal and anthracite coal mined in the United States and Canada was approximately 547,000,000 tons. As previously stated it is computed that in the conversion of the energy of coal into useful work in the steam plant we are throwing away at least 90 per cent of the energy of this coal.

The railroads are probably the most inefficient users of coal. Even with the best steam locomotives, only the smallest fraction of the energy of the coal consumed is obtained as power. Most of it goes through the smokestack and in the exhaust from the cylinders. Steam locomotives in the year 1911 used more than one-fifth of the 547,000,000 tons of coal mined; that is, over 100,000,000 tons of coal a year is shovelled into the grates of the steam locomotives in the United States and Canada. The electrification of railways and the use of hydro-generated electric power for the purpose of propulsion is becoming more and more of a necessity. We should also consider the reduction of fire waste in the

forests due to the elimination of the spark shedding locomotive as an additional return to the nation on the investment.

Let us turn from this matter of conservation of our fuel supply and consider another aspect of the question. The most convenient method of utilizing energy is in the form of electrical power and such electrical power can be now transmitted economically hundreds of miles from the source of supply. In this country of ours, with an abundance of water power ready at hand, the energy furnished free of cost by nature itself, it is, I believe, within reason to hope that the use of coal for power purposes in our large cities will before long be almost entirely abandoned and that hydro-electric power, economically transmitted and distributed, will in time light every home and drive every factory in this country. Even now the public is dependent in most cities every day upon one or more of the manifestations of this hydro-electric energy. Electric power, heat, light, transportation by electric cars, are incessant manifestations of this force. These are no longer luxuries but necessities of our domestic life. It is a fact, however, that many people who rely on this very docile and obedient servant for the conveniences and some of the necessities of life little know of the strict course of discipline which has to be maintained to keep that same servant in his place, or of the many years of patient research and tireless endeavour before the proper code of rules to be enforced to govern the department of that servant had been formulated.

Long distance transmission of electric power dates from the year 1882, when Monsieur Marcel Deprez at the Munich Electrical Exhibition transmitted about one horse-power a distance of 35 miles to a place called Wiesbach. Direct current at 1,300 volts was used and the transmission line was an ordinary telegraph circuit of iron wires.

In 1891, one hundred horse-power of electric energy was transmitted from Lauffen to Francfort, a distance of 81 miles on three copper wires, carried on insulators in a way very similar to that used at the present time. This was an alternating current transmission at 40-cycles, 3-phase, 8,500 volts. It was built for demonstration purposes only.

Some wonderful feats in electric power transmission have been accomplished since that date. The voltages have steadily risen from a few thousand volts in 1891 to the voltage of 150,000 volts of the Pacific Light & Power Company of Los Angeles, California. This company is transmitting over 100,000 h.p. a distance of 240 miles at this voltage—the highest commercial voltage known to-day. The company has over 1,180 miles of high voltage lines. The Southern Power Company in Maryland operates approximately 350 miles of 100,000 volt lines. It covers half-a-dozen States in the Union, generating and transmitting over 75,000 h.p. Practically every city and town in the Province of Quebec, Ontario, Manitoba and British Columbia is largely supplied with light and power generated through hydro-electric development. Quebec City and the surrounding districts obtains its electric current from the Montmorency and Chaudiere Falls; Montreal and the surrounding districts from Shawinigan Falls, 85 miles away, also from the Lachine Rapids, the Richelieu River, the Beauharnois Canal; again a large development on the St. Lawrence River at the Cedar Rapids is now in course of construction, with initial development of 100,000 h.p. Ottawa City obtains its power from the Chaudiere Falls—large developments are there in existence and extensions are now under construction. The whole of South-western Ontario, including Toronto, obtains its power from Niagara Falls. In the West, Winnipeg is amply supplied with hydro-electric power from plants built on the Winnipeg River; Vancouver and the Pacific Coast towns are supplied by large hydro-electric plants—the largest of which is that of the Western Canada Power Company, with a maximum development of nearly 100,000 h.p.

The prodigal displays of nature's might at a waterfall or rapid, when intelligently harnessed and converted into electric power, can be transmitted and distributed economically in a territory covering hundreds of square miles. This is the work of the electrical engineer and he is surely playing a leading part in the drama of human progress.

The tremendous development in the application of electrical energy which has taken place in the last ten years is to a large extent a result of the progress which electrical engineers have made in the economical transmission of electrical energy over long distances. This has rendered possible the supply of electrical energy for industrial, domestic and other purposes by tapping these sources of energy which exist in the innumerable rivers and streams flowing to the sea from the high lands.

Battery with Machine Pasted Plates

By J. D. Lachapelle

The Vital Factors in Storage Batteries

The quality of its plates more than any other factor determines the kind of service a storage battery will give. Look at a battery plate and you will see the outlines of a grid or latticed metallic frame buried in the body of the plate. The body is composed of a substance which has been compacted into the grid. When the battery is in service this substance is in a state of great chemical activity and is, therefore, known as the active material. The grid holds the active material in position and acts as the conductor of electric current into or out of the plate. Other things are important in battery service, but the active material is of paramount importance.

There is a stage in the making of battery plates where we have empty grids and paste. It is the paste which, after being applied to the grid and going through an electro-chemical treatment, becomes the active material. The latter inherits its potent qualities from the paste—it is simply the paste transformed.

Paste is, therefore, of the utmost importance—so far as service given the owner of an electric car is concerned, the paste is the battery and it is on paste that the researches of many clever chemists have been centered. However, experience has shown, also, that the paste in its final effects is as good or as poor as the method used in applying it to the grid. Paste and pasting are, therefore, the vital factors in making storage batteries.

Homogeneity—The Proof of Excellence in Battery Plates

If, after two pieces of steel are welded, there is one homogeneous whole without crevice or weakness at the joint, the weld is perfect, otherwise not. Cement, Plaster of Paris, etc., may be made plastic by mixing with water, but immediately begin to set and this setting progresses rapidly to a stage where it will prevent one body of cement from adhering to another. Setting is, therefore, a factor to be dealt with in welding into one homogeneous whole certain plastic substances, notably battery paste.

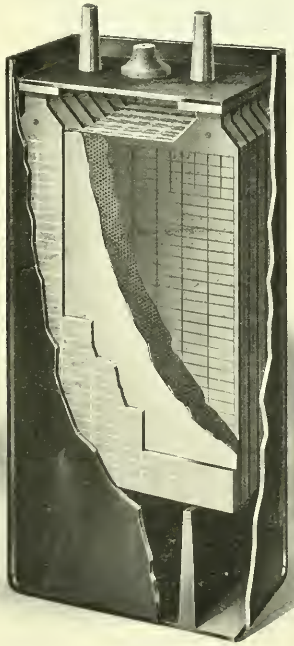
Battery paste sets with extreme rapidity and the possibilities which setting has for defeating the good intent to

make high grade batteries are given full scope by the method heretofore used in applying the paste.

In a perfect plate the active material is homogeneous throughout. It is of the same density from top to bottom and from face to face, without hard and soft spots, and adheres evenly to the bars of the grid. Perfectly homogeneous active material could not be secured with consistency by the old style pasting method—chance was too large a factor.

Hand Pasting

Here is a pen picture of old style pasting. In front of the workman is a grid lying flat. Beyond the grid a heap of freshly mixed paste, setting every second it is exposed to the air and also changing chemically because of the active elements within the mass. The workman scoops up a dab of the soft substance and slaps it into the upper side of the grid. With great energy, and using his strength, he manipulates the paste, rubbing it back and forth with peculiar flourishes of his trowel. Working at top speed he gradually succeeds



The machine pasted plate.

in getting the paste into the mesh of one side of the grid. Then he flops the grid over and hurries to get the other side pasted before plasticity fails. The time consumed in hand pasting permits "setting" before it is desirable, particularly over the surfaces where the paste applied on the second side meets the paste applied some time before on the first side. The result is an uncertain weld and a more or less imperfect adhesion to the bars of the grid. The defects of hand pasting, therefore are:—

1st. On each side a variation in density of the material with hard and soft spots regardless of the expertness of the workman.

2nd. The principal causes of weakness and uncertain electrical efficiency hidden in the heart of the plate where it is vital that conditions be definite.

The result was an uncontrollable lack of uniformity in the behavior of different parts of the plate when put into service and in the behavior of one plate as compared with its neighbor and of one battery compared with another in the same service. The personal equation among workmen always counts, but, even so, the quality of plates produced by the best workmen varied, due to causes beyond his control. There was too much luck in the process. Homogeneity in the active material could not be assured, and the resulting variation in the behavior of batteries was a disturbing element in the battery business. However, the defects inherent in old style hand pasting are now avoided by a new process, and uncertainty gives way to certainty. The answer to the problem has been found in the "machine pasted" plate.

The Machine Idea—Obviously Correct

Assume that the paste could be applied by means of a machine. At the top is a hopper containing the paste. Battery grids are fed into a slot just large enough for the purpose and disappear into the heart of the machine, where the mechanism forces the paste into both sides of the grid simultaneously. The two masses of paste which approach each other are of identical composition. Setting is postponed until after the pasted plates emerge from the machine. Thus there is an absolute weld, perfect adhesion to all the grid bars and uniform density throughout. The thing desired, homogeneity, is achieved and with it the elements of durability and electrical efficiency.

This is no new idea. Battery engineers have wrestled with it for years. The thing that balked them was the paste—it would not work right in the machine, would not flow properly into the mesh of the grid and fill up solidly without cracks. To find a new paste composition which would work in a machine and yet sacrifice no chemical activity was the problem imposed upon chemists. After years of experimentation the desired end has been achieved, service tests have proven the principle and the "machine pasted" plate is now offered to the public as a product unique in the storage battery business. The active material is of the same composition, density, and hardness from top to bottom and from face to face and in absolute bond with the grid, and thousands of plates may be manufactured with the assurance of uniform service results. Two distinct advantages are offered to owners of electric cars and trucks by machine pasted plate batteries.

1st. Better battery service.

2nd. A guarantee without extra charge.

The frequent imperfect service of old type pasted batteries, and the effect this had on the battery business led to guarantees, but the necessity for protection against the risk caused by the uncertainties of the manufacturing process resulted in an extra price for such guaranteed batteries.

The machine pasted plate battery is the first battery of any type offered to the public with a guarantee for which there is not an extra charge of from 100 to 300 per cent. added to the normal selling price. This battery is guaranteed for either pleasure car or truck service.

These batteries are now being manufactured by the United States Light and Heating Company, Niagara Falls, N.Y.

The A. E. Rittenhouse Company, Honeoye Falls, N.Y., are offering in the Canadian market an exceptionally attractive store window display in the form of a miniature electric aeroplane. This toy is operated on four to eight dry cells or on an a.c. lighting circuit with toy transformer and on a d.c. circuit with voltage reducer. The same company also manufacture among other specialties a neat toy transformer with primary 100 to 125 volts and secondary 3, 6, 10 or 20. The only live parts exposed in this transformer are two binding posts, the voltage being controlled by a lever which operates the contacts inside the transformer case.

Phase Advancers—Power Factor Correction

By G. Morrison, M.I.E.E.

The influence of power-factor on an electric supply system is important in several ways. It affects the capital outlay, earning capacity, operating costs and voltage regulation. Operation with low power-factor means that for a given kilowatt output, generators, lines and transformers have to be built larger than would otherwise be necessary. In addition the voltage drop and power losses in lines and transformers are greater and the generator regulation poorer.

In the case of a supply company the total cost of production of the power sold to consumers is determined not by the true kilowatts but by the output of kilovolt-amperes and the company must therefore secure the highest power factor commercially possible or, alternatively, base its charges on a system which will take into account the power-factor of the individual consumer's load. In the case of a manufacturing or mining company having its own electric power plant the same considerations hold and the question is at least as important.

Improvement of Power-Factor

There are in Canada several power companies and manufacturing concerns whose system power-factor is low, the usual cause being induction motors which are either underloaded, or running at reduced speeds or which are of the large slow speed type. The improvement of this power-factor would in almost every case offer advantages whose value would render the additional outlay required to secure them a profitable investment. This is especially true in the case of steam-driven generating plants and those plants where the generators are now being worked at almost full kv.a. capacity. With a better power-factor the same actual kilowatt load can be supplied by a smaller number of units whose prime movers will then be run at a more economical load so cutting down fuel consumption. Again, with the improved power-factor a plant which formerly operated at or near full kv.a. capacity will be able to supply the same true kilowatt load with fewer kv.a. and the balance will be available for additional power demand. These advantages, apart from the others of lesser importance, make it worth while considering the methods of obtaining power-factor improvement which can be divided into two classes. The first class covers synchronous condensers and over-excited synchronous motors and rotary converters. The second class comprises all those devices intended for use in connection with individual motors, one condition necessary for their use being the presence of one or more large induction motors running continuously. The first method is best suited to cases where the motors are small or running intermittently but has some disadvantages, the most important being that the excitation must be adjusted to suit varying load conditions. The second method, which includes the use of phase advancers, the subject of this article, gets right at the cause of the trouble by correcting the power factor of the individual motor.

Phase Advancers

Up to the present time the development of the phase advancer has been carried out wholly by European manufacturers, Messrs. Brown Boveri & Company pioneering the way in this particular line. The advancer which they have standardized is a special three-phase commutator machine which is electrically connected to the slip rings of the motor whose power-factor is to be corrected. The rotor of the machine carries a drum winding, the bars of which lie in slots in an iron core, and are connected to the commutator in a manner similar to the windings of a direct current armature. The smaller sizes of advancer have no stator but in order to provide a closed path for the magnetic field the rotor core is so designed that the winding is at a considerable depth below the surface so that in effect it is surrounded by a closed ring of iron. For very large motors and for special cases a wound stator is used. The theory of the action is simple:—If the motor is running and the advancer standing the rotor current will flow through the advancer and the latter will act as a choking coil causing a reactive drop and a lag in the current. For a given current this drop depends only on the frequency, that is, on the rate at which the rotating field set up in the advancer cuts the winding. If the rate of cutting is reduced by rotating the winding in the same direction as the field, the reactance and therefore the lag decreases, and at synchronism becomes zero.

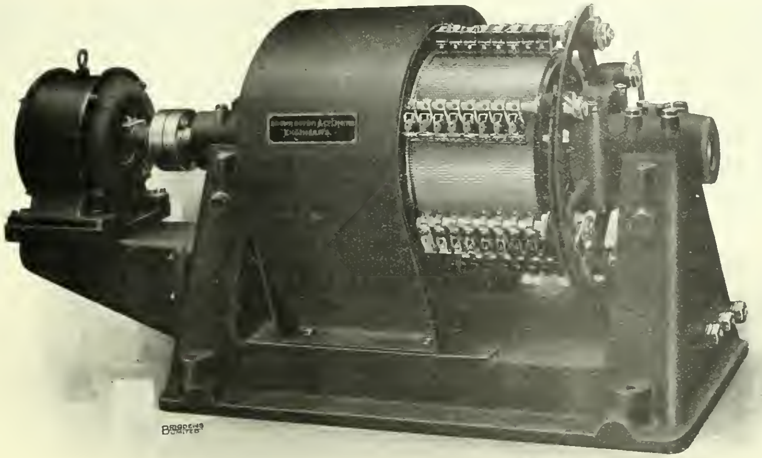
When the speed is raised above synchronism the reactance attains a negative value, the phase advancer acts as a capacity and the current is made to lead. The advancer being run at a speed which gives the required lead the wattless component of the magnetizing current of the motor is provided with the result that the latter takes only watt current from the line, that is, the motor operates with 100 per cent. power-factor. Going still further in the same direction the motor can be given a leading power-factor and so provide the wattless magnetizing current for other motors on the same system.

The driving of the advancer can be done in various ways. It can be direct coupled to the main motor if this is a high speed machine, or if low speed then the advancer can be driven either by belt from the main motor or by a separate small motor. As the current which the advancer supplies is wattless the driving power is small being only that necessary to overcome friction and windage.

The cut shows a Brown Boveri phase advancer driven by a small three-phase induction motor and it will be seen that this advancer has no stator but simply a steel guard for protection.

The connection of an advancer either to an existing motor or to a new one is simple. The leads from the motor slip rings are fitted to a three-pole double throw switch which on one set of contacts connects the rings to the starter and on the other to the advancer. The motor is run up with the starter in the usual way and when up to speed the double throw switch cuts out the starter and connects the slip rings directly to the terminals of the advancer which has already been brought up to its normal speed. The operation of the advancer is then wholly automatic, the power-factor of the motor being kept at 100 per cent or other predetermined value over a wide range of load without any regulation.

A motor when fitted with an advancer maintains its synchronous character and possesses the additional advantage that the maximum torque which can be developed is greatly increased so that heavier overloads can be handled before the motor is pulled up. Its efficiency remains at least as high as when running alone and in some cases it is improved. Further the phase advancer lends itself to improving the performance of large slow speed motors operating on a severe service such as the driving of continuous rolling mills. In such a case the design depends not so much on considerations of heating as on the difficulty of getting a good power-factor without sacrificing mechanical reliability. By the use of an advancer a high power-factor can be obtained and at


Brown Boveri Phase Advancer.

the same time the air gap can be made larger than in the case of an uncompensated motor.

Examples of Benefit

A good example of the benefit derived from the use of an advancer is the case of a 700 h.p. rolling mill motor in an English steel works. This motor works much underloaded and its power-factor adversely affected the efficiency of the works' generating plant which operated at a power-factor of about 55 per cent. An advancer was applied to the motor to raise its power-factor to 100 per cent and when switched in the current taken dropped by 50 per cent. This raised the power of the system to 70 per cent and considerably reduced the production costs as, owing to the decreased amount of wattless current to be dealt with, one generating unit was shut down and the other worked at a load within the capacity of its generator and also economically as far as the steam turbine driving it is concerned.

The advancer of this rolling mill motor was driven at 1,500 r.p.m. by a 2 h.p. motor this covering the maximum amount of power required under any condition of load.

The use of phase advancers is confined to medium and large sized motors and in many cases it will be found possible, by using advancers on one or more of the larger motors and correcting their power-factor to a leading value, to bring the power-factor of the whole system to somewhere in the neighborhood of 100 per cent. The advantage of this as far as increased revenue earning capacity is concerned may be shown by an example.

Taking a system running fully loaded and giving 4,000 kw. at 80 per cent. power-factor, that is, 5,000 kv.a. Assuming two motors, each of 800 h.p., operating at 80 per cent power-factor, have this raised to 100 per cent by the use of advancers. The power-factor of the whole system will be raised to 90 per cent, corresponding to 4,500 kv.a. for the same 4,000 kw. output. This means that 500 kv.a. will be set free for sale and additional revenue and whether the prime movers are water, steam or gas driven the cost of the advancer installation will be earned in a comparatively short period.

The writer is indebted for the above information to The Canadian Crocker-Wheeler Company, who handle the Brown Boveri manufactures in Canada.

Artistic New Lighting in Old Theatre

The theatre-going public must be pleased not only with the performance but also with their physical comfort at the theatre they attend. Realizing this, the Pitt Theatre, of Pittsburg, recently remodelled the entire equipment and installed the latest improvements in lighting. The details are of interest as there is much theatre building going on now owing to the steadily increasing popularity of the moving pictures. Illumination for this class of work is special and there is a noteworthy lack of definite information on the subject available.

The following description of the Pitt will serve as an example of recent practice. The main ceiling has 3 Parian bowls, a 500 watt lamp in each, hanging 20 ft. from ceiling. In front of the second balcony are 14 8-in. Parian acorns, a 40 watt lamp in each. In front of the first balcony are 17 Parian panels with two 16 c.p. carbon linolite lamps and Frink reflector behind each panel. Ceiling over first balcony 4 Parian bowls, 250 watt lamp in each. Second floor corridor, 6 bowls, 150 watt lamp in each. First floor corridor, 5 bowls, 250 watt lamp in each.

Newel post at foot of stairs, Parian urns, 150 watt lamps in each. Under first balcony, 4 bowls, 250 watt lamp in each. First floor box, 8 bowls used as ceiling lights with three 25 watt round bulb tungsten lamps in each. Second floor boxes, 8 Parian acorns, suspended with arms so that they give the appearance of urns, 150 watt lamp in each. The height of main ceiling is about 40 feet. Floor space of main floor including corridor, 80 ft. x 100 ft. Floor space of first balcony about 35 ft. x 100 ft.

The color scheme of the theatre is blue and old ivory. The hangings, draperies, etc., are dark blue. All the glass work is decorated light blue and old ivory, with blue band—the fretwork on the Grecian band being brought out in blue. For the ladies' retiring room special bowls colored old rose to match the hangings were selected.

Electric Arc Welding in Machine Shops

The use of the electric arc as a source of heat for welding, cutting and melting metals is one of the oldest applications of electric power, yet is the one most recently developed to a commercially practical degree for general purposes. As long ago as 1786 experiments were made with the arc as a source of heat, by using battery current, and from that time until today there has been a more or less steady interest taken in the subject. In 1887 Benardos and Olszewski developed a practical method for using the heat of the arc commercially, using an electrode of carbon and drawing an arc between the work and the carbon. The arc was used as a flame and a bar of filling material melted into place for welding. The arc derived in this manner is also used for cutting, by melting the material, from the piece worked upon. In 1891 Slavianoff further improved the method or process by using a piece of the filling material as the electrode and melting it directly into place with the arc. This is the most universally applicable method of welding and is most used today.

Welding or cutting may be done with an arc from any source of direct or continuous current if means are provided for regulating the amount of current flowing, but experience shows that it is necessary to introduce certain refinements into the controlling system in order to insure satisfactory commercial results. It will be obvious that merely depositing metal with the arc will not necessarily be doing a good piece of work, so various means of controlling the arc have been devised. It is in the type of controlling apparatus supplied that most of the difference lies between the various outfits on the market today, and that apparatus offering the most protection for both welding machine and article welded is the best. It is not sufficient to have a limiting resistance, or even the addition of an automatic circuit breaker to open an overload, but it is also desirable to have means for limiting the flow of current on short circuits when establishing the arc. And, the more nearly automatic these devices are the better it will be for the work.

In order to weld or cut with the electric arc it has been found best to attach the positive side of the circuit to the article worked upon and the negative side to the electrode holder. This is due to the fact that the positive terminal or electrode of any arc attains a higher temperature than the negative, and since the article is larger than the electrode it will carry off the heat faster, so in order to fuse the article at the spot worked upon it is necessary to give it more heat. To draw an arc it is simply necessary to touch the electrode to the article, withdraw it instantly to a short distance and the current will cross the gap so long as it is not great enough to rupture the arc. By moving the electrode about over the surface to be welded the heat will be always available, because the arc will follow the electrode due to its passing from the article to the electrode. If it passed the other way it would be more erratic, and less effectual.

Two systems of arc welding are in commercial use today, each of them taking its name from the man who first developed it commercially. One of these is the Benardos system, and consists in using a carbon electrode and melting in a piece of filling material. This is also used for cutting. The other system is the Slavianoff method of using a piece of the filling metal as the electrode and melting it into place direct with the arc. The latter system is the one used for steel sheet and plate work and for steel castings, and the Benardos system is used for cast iron, copper, aluminium and large steel casting welding. Direct current at about 70 volts is used for both systems and a compound-wound generator driven by a motor gives much better voltage control than any other source of supply. Several manufacturers offer welding outfits, but the most satisfactory outfit is that one with the most complete control system and prospective purchasers should investigate all of the various systems before purchasing. Most makers use motor-generator sets, but one maker offers merely a set of iron grid resistances in spite of the very low efficiency of such a system for reducing the voltage to that required for welding. A barrel of water with two plates in would do as well and be cheaper.

Sheet steel as thin as 28 B.W.G. has been successfully welded by one manufacturer and articles of 20 gauge are in regular production. From this point there is no limit to how large an article may be in order to weld it successfully,—locomotive side frames, heavy steel shafting, frames of machine tools, boilers and practically every article of iron and steel has been welded. Brass is rather hard to weld successfully because the zinc volatilizes and passes off easily, but castings of medium and large size can be handled readily. Other alloys of copper may also be welded, as may also aluminium castings, copper sheets and other metals. Broadly speaking, the metallic electrode process is limited to articles of iron and steel, whereas, the graphite electrode process may be used for any metal, the only limitation being that the work must be in a horizontal position to prevent the molten metal running off the piece because that is largely a "puddling" process. When cutting it is necessary to give the metal a chance to flow, of course.

For welding iron castings it is desirable to pre-heat the piece in order to expand it in the proper direction and prevent cracking due to shrinkage when cooling, and also to insure welds that will be soft enough to machine afterwards. This latter point will also be better insured by re-heating the piece after welding and cooling as slowly as possible. A good flux is necessary for cast iron welding in order to raise the slag and insure a homogeneous weld. Other metals require no fluxes. There is apparently no limit to the articles which may be welded with the electric arc and such apparatus is being adopted rapidly by manufacturers in every line, steam and electric roads, marine repair companies and iron and steel foundries. Owing to the low cost of operation an outfit of this sort will, it is claimed, return its cost in a very few months if used in place of any other system of welding or joining metals.

Addition to Kaministiquia Power Plant

The Kaministiquia Power Company of Fort William, commenced a few weeks ago the addition of an extra unit of 12,000 horse-power capacity to their plant. This extra unit is almost double the capacity of any one of the three units totalling 22,000 h.p. that constitutes the present plant. The new addition to the Kaministiquia Power Company will cost approximately $1,000,000. The company have some 350 men working on the building of the new aqueduct at Kakabeka and have also let three contracts that gives employment to another 100 men. With the regular staff, construction gangs and contractors 500 men will be employed steadily for the remainder of this year.

Moose Jaw, Sask.

A new plan has been submitted to the light and power commission for the supply of electric power at a low rate, this power to be developed in the Estevan coal district. The proposition is understood to be to manufacture electric energy by gas-heated boilers the gas being a by-product in the manufacture of briquettes from the lignite coal.

Electric Railways

Electric Locomotive Design

By E. V. Pannell and W. K. Gratwicke

The rapidly increasing development of Canadian water powers, together with the widespread distribution of electrical energy, tend to the conclusion that the railways of the Dominion will sooner or later be operated to a considerable extent by electricity. In all other countries where fuel is dear and water power available the same result is being brought about; first the suburban and interurban lines and

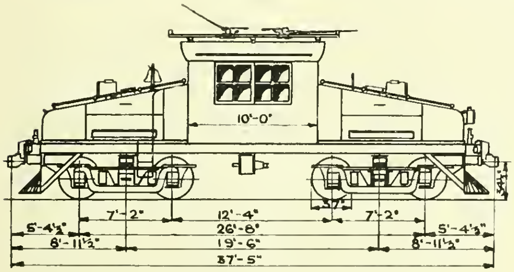


Fig. 1 Oregon Electric Railway Locomotive, Class A.

later the mountain and trunk line divisions being converted from steam to electrical operation. The fact of electrical railway work being pursued in so many different countries having different conditions and engineering standards makes a comparative study of the case a very interesting one and in the present article a comparison is made of some of the outstanding forms of motive power in use for train propulsion on electric railways. On two of the principal Canadian railroads electric locomotives will be running at no very distant date; a survey of the development of this class of machine is therefore of topical interest.

Although in the very early days of electric traction gearless locomotives were quite common they were largely superseded for general work by the type shown in Fig. 1. This represents a machine built by the General Electric Company for the Oregon Electric Railway and is of the well-known two-bogie type having a motor geared to each axle. This form of machine (which may be designated Class A) is too well-known to need detailed description; maximum adhesion, flexible wheelbase, and interchangeability of parts with motor-car equipments are its main features. Many hundreds of machines of the type shown are in operation in all parts of the world for all classes of service and the design has been adopted as a standard by practically every builder.

When the directors of the New York Central and Hudson River Railroad decided upon the electrification of their trunk lines out of New York City it was realized that a special type of electric locomotive was necessary. Not only was high running speed a prime requisite but for operation in a crowded terminal high acceleration was also essential. High speed postulated gearless motors, whilst high tractive effort required maximum adhesion. The solution of the problem was afforded by the Mohawk machine, especially designed by the General Electric Company for this service. In its original form it had leading and trailing pony trucks but the wheel arrangement was subsequently modified in accordance with Class B (Fig. 2). In general it may be said that for high speed service the four wheel leading truck has shown itself just as necessary in electric as in steam practice. The most interesting feature of the Mohawk locomotive is, of course, the motor system. The armatures are keyed to the axles and the bi-polar fields are bolted to the frames; this

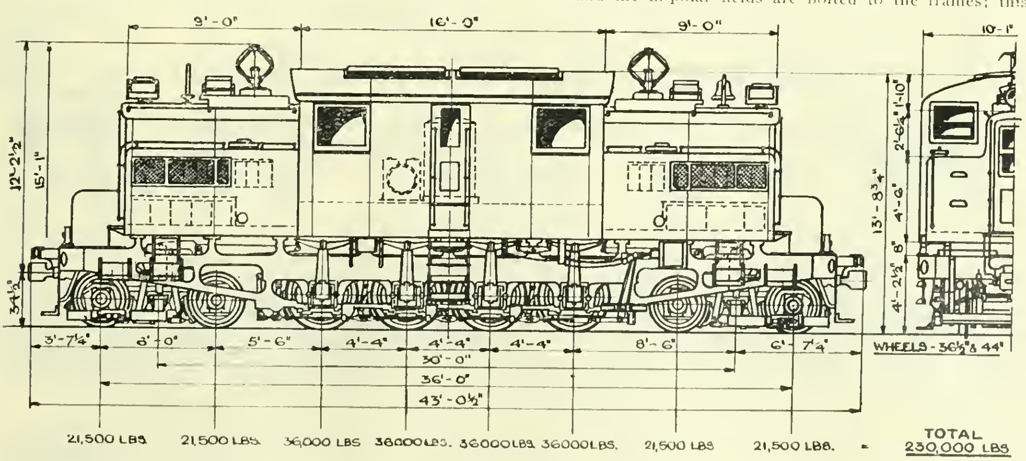


Fig. 2. New York Central Locomotive, Class B.

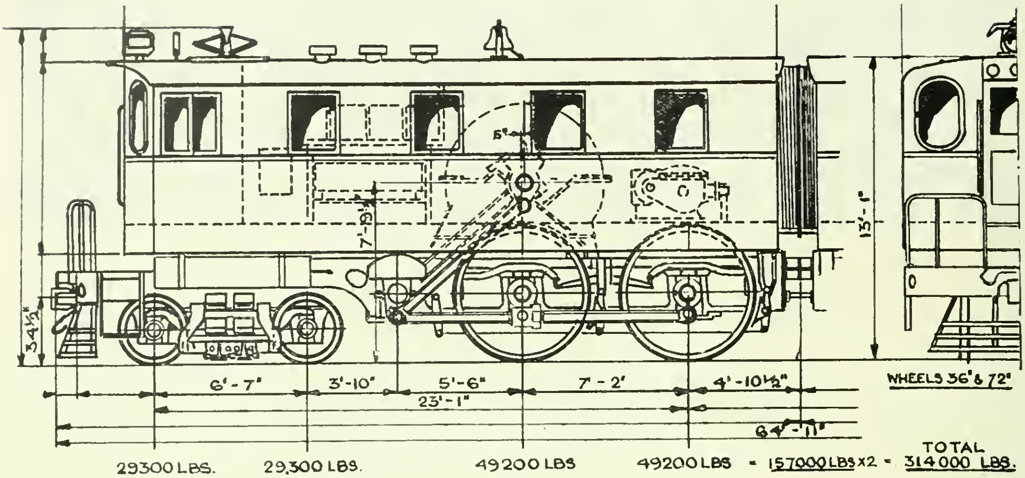


Fig. 3. Pennsylvania R.R. Locomotive (Half-Unit,) Class C.

permits of vertical motion of the axles and relieves the axle of all dead load except that of the armature.

After the introduction of the New York Central machines in 1907 many interesting forms of gearless locomotive were designed. Several of these appeared upon the New Haven Railroad and will be described later. At this time it was argued, particularly by European engineers, that a high center of gravity conduced to steadier running of the locomotive and to a great extent eliminated nosing and vibration. The natural deduction was that the proper place for the motor was above the frames driving the wheels through side rods and cranks. This permitted the employment of large motors of substantial design and ample ventilation and driving wheels of 60 to 70 in. diameter. After experimenting with two machines of the articulated type the Pennsylvania adopted the side rod engine for the operation of their Hudson River tunnel in New York and one-half of their complete locomotive unit is shown at Fig. 3 (Class C). It is interesting to compare this with the Class B locomotive last described; both are of about 2,000 h.p. on the one-hour rating and both have the same number of driving and idle wheels. Class C is, however, 50 per cent. heavier and has a 50 per cent. longer wheelbase. Nevertheless, published reports go to show that the Class C locomotive has performed excellent work and a large number are in use by the above mentioned railroad for their tunnel service. The opinion of railway engineers is, however, becoming opposed to the electrical side-rod machine, and it is not likely that any further examples will be built in America. The heavy unbalanced moments produced by the conversion of the rotary motion to a thrust and back to a rotary motion again are a source of trouble and demand such fine adjustment of bearings and journals that this type of machine lacks the rugged characteristics of either the Mohawk or the geared locomotive.

On the New York, New Haven & Hartford a very interesting series of locomotives has been developed, of which a gearless and geared form are illustrated respectively in Figs. 5 and 6 (Classes D and E). The gearless machine, which was first introduced in 1907, departs from New York Central practice in that the armatures are not keyed to the

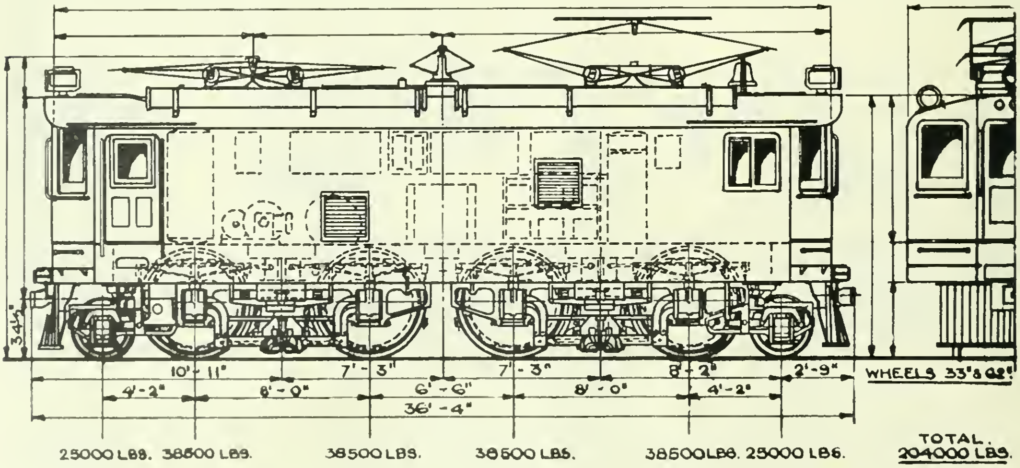


Fig. 4. New Haven Gearless Locomotive, Class D.

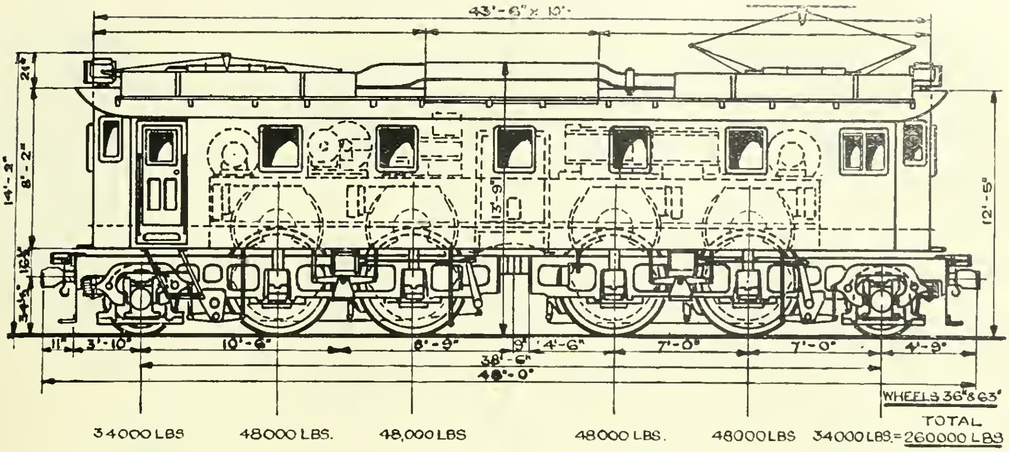


Fig. 5. New Haven Geared Locomotive, Class E.

axles but to quills which float around the axles and are separately sprung on their own bearings. The drive is by a spring claw engaging in pockets on the inner side of the wheel at either end. By this means the whole motor is spring supported, whilst at the same time the advantages of a concentric drive are obtained. Type D was first put upon the road as an eight-wheeler without the leading and trailing wheels, but the usual nosing trouble appeared to render a twelve-ton leading truck a vital necessity.

For a given class of service, provided that armature speeds do not exceed judicious limits, geared motors are preferable to gearless on account of lower cost; if therefore a gearless machine can be superseded by a geared one having exactly the same characteristics the latter will be a cheaper machine. In general, however, unless the gear ratio is very low, it will be better adapted to freight than to passenger service. Class E (Fig. 5) represents a further development of the New Haven design and is practically identical with the last mentioned save for the use of geared motors. The gear wheel is now keyed to the quill and the motor bears upon and is vertically above the quill and axle. Owing to the maximum torque of the motor reaching a value of 11,000 lbs. it was found necessary to design with a shorter motor axis and to use two gears, one at each end of the shaft to avoid twisting of the motor shaft or the quill. Besides the examples of Class E operating on the New Haven Railroad this pattern has been duplicated for service on the Hoosac Tunnel Division of the Boston & Maine Railroad.

The third outstanding design in use on the New Haven Road is Class F or the Colonial type shown in Fig. 6. Briefly, this is Class E modified to employ eight small motors instead of four large ones. In this case as each gear wheel has to transmit the torque of only one 170 horse power motor through any one tooth it suffices to use a single gear. By this means the motor can be designed with a greater axial length and so is a more compact and better ventilated machine. A further advantage is that the small armatures and other details are interchangeable with the similar parts on motor-car equipment so that a relatively small number of spares is called for. These features have combined to render the Colonial type one of the most useful locomotives in use on the New Haven Railroad. It should be mentioned that the interesting trilogy of designs, Classes D, E and F, are all due to the Westinghouse Company of Pittsburgh.

The Class A locomotive already described was considerably limited in its scope owing to the fact that it was mounted on two bogie trucks of the ordinary motor-car type; the drive therefore had to pass through the king-pin of each

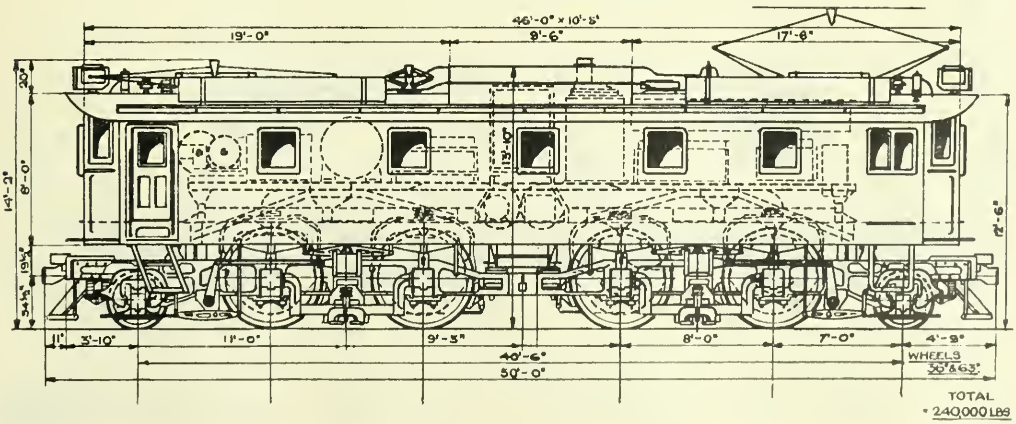


Fig. 6. New Haven "Colonial" Locomotive Class F.

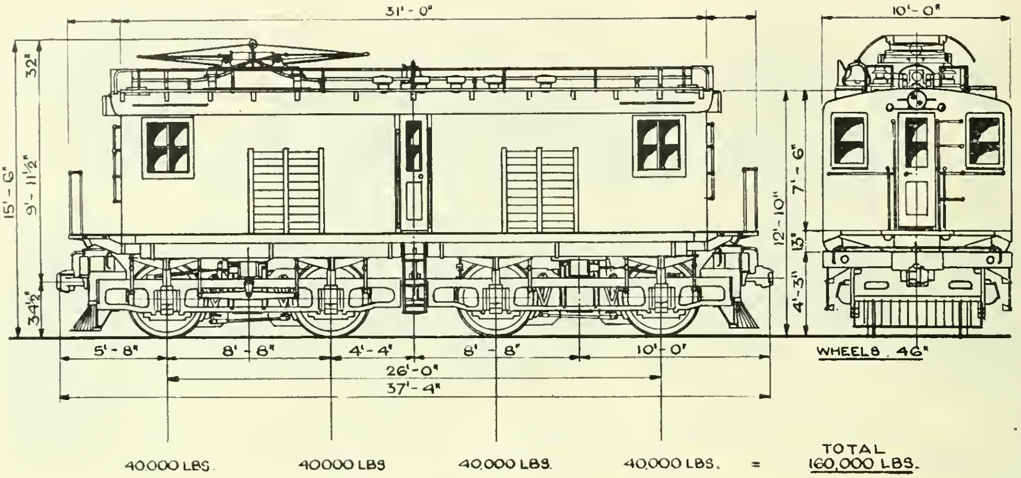


Fig. 7. Butte Anaconda and Pacific Locomotive, Class G.

truck. With the introduction of the articulated machine, however, the trucks take both the drive and the pull, and are independent of the body of the locomotive. At the same time it is possible to employ larger motors and wheels with this type of machine. Fig. 7 illustrates this type (Class G) and it is interesting to note that the machines being built for the Canadian Northern service in the Montreal tunnel are practically identical with that shown in the figure. As will be observed the trucks are linked together and themselves form a complete locomotive, the cab being merely a housing. The motors are geared in the usual manner but owing to the exceptionally heavy torque to be transmitted the gearing is necessarily of very heavy design and in some instances double gearing has had to be employed in this form of machine. (This applies to the locomotives working on the Detroit River Tunnel and the Baltimore Belt). It has been confidently predicted by experts that the Class G locomotive represents the last word of design for extra heavy passenger, freight and terminal service.

The last machine to be described is that shown in Fig. 8 and is a development of the Mohawk type Class B. The colloquial name applied to the Class H locomotive is the "Caterpillar," and this well represents the flexible characteristics of the machine. The complete wheelbase is utilized for adhesion and four articulated trucks are used each being equipped with two motors of the design employed in Class B. The weight and horse power are almost the same as in the case of the machine last referred to, but the tendency to use a large number of small motors instead of fewer large ones is followed. The Class H locomotives have been tested out at high speeds and found to give extremely steady running.

Some of the main particulars of the locomotives described are included in the table which follows. In dividing locomotive designs into eight main types it is not intended to imply that these exhaust all the practical designs, but merely that they represent a series of distinctive machines, and indicate to some extent an evolutionary progress.

The electric railway being built by the Lacombe & Blindman Valley Railway Company will be completed from Lacombe as far as Gull Lake by July 1. It is expected that the first gasoline electric car will be ready to operate this part of the line by that date.

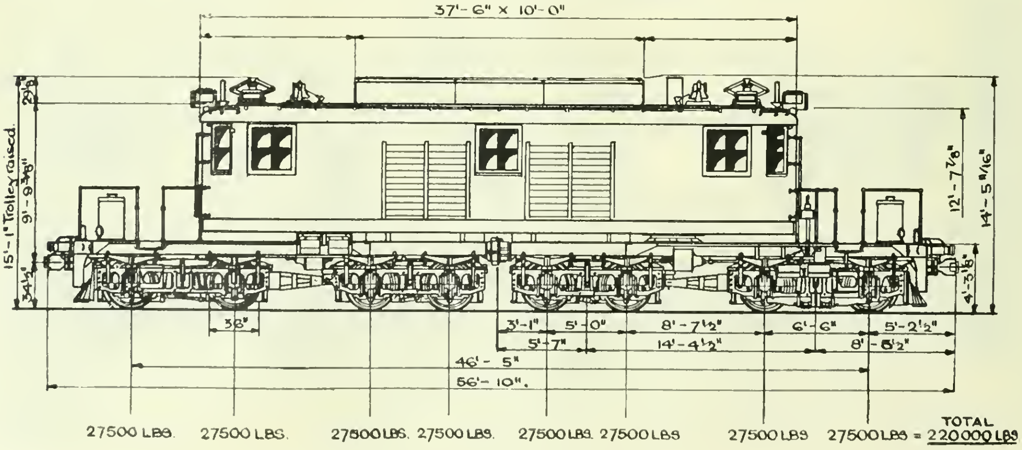


Fig. 8. New York Central Locomotive, Class H.

TABULATED DATA OF ELECTRIC LOCOMOTIVES (See article by Pannell & Gratwicke)

CLASS	A	B	C	D	E	F	G	H
MAKERS	G.E. Co.	G.E. Co.	Westinghouse	Westinghouse	Westinghouse	Westinghouse	G.E. Co.	G.E. Co.
RAILROAD	Oregon Elec.	N.Y.C.	Penna. R.R.	New Haven R.R.	New Haven R.R.	New Haven R.R.	Butte Anaconda	N.Y.C.
WHEEL ARRANGEMENT	4-4 Bogie Trucks	4-8-4 Rigid Frame	4-4, 4-4 Coupled Units	2-4, 4-2 Articulated Trucks	2-4, 4-2 Articulated Trucks	2-4, 4-2 Articulated Trucks	4-4 Articulated Trucks	4-4, 4-4 Articulated Frame
DRIVE	Gear	Direct	Side Rod	Quill	Geared-Quill	Gear	Duplex-Gear	Direct
WEIGHT, LBS., TOTAL	100,000	230,000	332,000	204,000	280,000	220,000	160,000	200,000
WEIGHT, ADHESIVE	100,000	144,000	197,000	154,000	192,000	182,000	160,000	200,000
TRACTIVE EFFORT, MAX.	25,000	47,000	60,000	19,200	40,000	45,500	48,000	13,500
TRACTIVE EFFORT, AS 20% ADH. WT	20,000	28,800	39,400	30,800	38,400	36,400	32,000	40,000
NO. MOTORS	4	4	2	4	1	8	4	8
H. P. EACH; 1 HR	100	550	1000	250	315	170	225	250
H.P. PER TON WT	8	19	12	10	9	12	11	20

Electric Railways and Letter Carriers

By the terms of an amendment to the Canadian Post Office Act passed by the House of Commons on May 4th and by the Senate on June 4th, the Postmaster General is given power to fix the rate at which an electric railway company operating in Canada shall carry a letter carrier on the street cars.

As the amended bill passed the House of Commons, Hon. L. P. Pelletier, Postmaster General, was given authority to fix whatever rate he deemed sufficient and any company who did not approve of his terms could not obtain redress. The Senate, however, altered the amendment as endorsed by the House of Commons and gave the right to a company to appeal to the Railway Commission for redress in the event of a dispute arising.

Clauses 8 and 9 in the amended act which applied to the rate at which an electric railway company should carry a letter carrier, as passed by the House of Commons read as follows:

8. Letter carriers in the service of the Post Office Department shall be conveyed on every electric railway in Canada, except municipally owned electric railways, on such terms and conditions and under such regulations as are made by the Postmaster General.

9. If any company operating such electric railway refuses to carry any such letter carrier at the amount so fixed by the Postmaster General, the company shall refund an amount equal to the difference between the amount so fixed and the amount actually expended for such carriage.

Clause 9 as above was struck out by the Senate and the following substituted:—

"And in the event of a dispute between the electric railways or any of them and the Department, the terms and conditions shall be fixed by the Board of Railway Commissioners for Canada, and in so doing due regard shall be had by the Board to terms and conditions agreed upon heretofore between the said electric railways and any of them and the Department."

During the discussion on the amendments on May 4th Mr. J. M. Douglas, M.P., objected to municipally owned railways being made an exception. In reply Mr. Pelletier said that in the experience of the Post Office Department there had been no trouble with municipally owned roads over the fixing of rates for the carrying of letter carriers. Continuing he said in part: "I have put this section in in order to show to other companies with which we have been having so much trouble—companies which are making enormous profits and which have no consideration for employees who are obliged to walk the streets with their loads—to show them that we intend to make a distinction between them and those companies which offer us fair terms. I want to make a clear distinction between the people who act in a fair way in the matter and those who demand from us prohibitive rates and if they do not get them decline to take care of the transportation of the men."

The Ontario Railway Board have made a recommendation regarding expenditures by the Toronto Railway Company. This expenditure requires the relaying of some 13½ miles of single track and the addition of 30 cars to provide sufficient accommodation for rush-hour traffic. The re-routing of a number of car lines is also recommended.

New Books

Telephone Construction, Installation, Wiring, Operation & Maintenance, by W. H. Radcliffe, E. E., and H. C. Cushing, Jr., E. E.; Norman W. Hanley Publishing Company, New York, publishers; price $1.00. This is a treatise describing and illustrating up-to-date methods of telephone practice, including the principles of construction and operation of telephone instruments; approved methods of installing and wiring them; the means of protecting them from lightning and abnormal currents; their connection together for operation as series or bridging stations; and rules for their inspection, repair and maintenance. Line wiring, and the wiring and operation of special telephone systems, as well as a complete explanation of automatic telephone exchanges are given. Intended for electricians, wiremen, engineers, contractors, architects, and all others interested in standard telephone practice. The reader is assumed to know absolutely nothing of telephony and no intricate mathematics are used nor is mention made of any apparatus, circuits or systems which are not thoroughly illustrated and described with respect to their construction, installation, wiring, operation and maintenance.

Electric Motors—B. Crocker, E. M., Ph.D., and Morton Arendt, E. E.; D. Van Nostrand Company, New York, publishers, price $2.50 net. This is a second edition of a treatise published in 1910 and contains many amendments and additions to make the subject clearer and more complete. Some sections have been considerably revised and enlarged as, for example, "starting box calculations for direct current, shunt and alternating current induction motors," and an entire chapter on the power requirements of various tools, etc., has been introduced. As set forth in the preface to the first edition the object of the authors has been to explain the operation of the various types of electric motor with sufficient clearness for most operators. Though the matter necessarily contains much that is technical, particular care has been taken in omitting descriptions which have no particular practical application. In the words of the authors the volume has been kept strictly within the limits of a handbook no attempt being made to produce an encyclopedia of the whole subject or an exhaustive treatment of any particular branch. The book contains 300 pages and is well illustrated and well printed.

Illumination

Street Lighting Units for Nitrogen Lamps

With the introduction of the nitrogen lamp it is appar ent that an entirely new line of suitable fixtures for same becomes a necessity. The nitrogen lamp fixture must be well ventilated and must be adapted for use with a variety of shapes and styles of lamps, and in the case of street lighting units it should also be capable of service on either series or multiple circuits with a minimum of structural changes. The firm of A. H. Winter Joyner, Limited, who have for a number of years made a special study of street lighting equipment, are now placing on the market a very complete system of fixtures, designed primarily for utilizing nitrogen lamps in the class of service in which they specialize. A few of these are illustrated herewith.

Two general types of fixtures have been developed, i.e., the pendant type, Fig. 1, and the patented pole top type, Figs. 2, 3, and 4. Both types are made in two sizes, the larger in each case being adapted specially for nitrogen units of 300 to 1,000 watts, both series and multiple, and are particularly serviceable for the "White Way" illumination of commercial and other important thoroughfares. The smaller size of each kind is more adapted for the lower power series nitrogen lamps, and for tungsten units from 100 watts to 250 watts. The smaller pendant type can also be used to good advantage in industrial, shop and other general work.

The more general form of the pendant type is shown in Fig. 1. The body consists of the best grey cast iron, accurately moulded, and so made that anyone can quickly adapt the unit to any size of lamp or from series to mulsired, or a combination globe and reflector apron can be sired, or a combination glob and reflector apron can be fitted. This unit presents an excellent appearance when mounted on a wrought iron bracket or with wire suspension fittings. The exterior is usually finished in black baked enamel, but can also be supplied with any bronze or other ornate finish desired.

Owing to the fact that a pole with a lighting unit mounted directly on top lends itself to most artistic treatment, a very strong reason for developing the pole top type of nitrogen unit is evident; especially when, as is the case, the excellent appearance can be effected without sacrificing any of the good illuminating qualities of the fixture. Fig. 4 shows a good design of this kind.

The nitrogen lamp, owing to its peculiar characteristics, must be burned tip downwards, and probably will always require to be so operated. At least it seems necessary that an ample cavity be left in the upper part of the bulb for the reception of deposits. This being so, the pole top type is well adapted to take care of this need as will be seen by reference to the illustrations. To make the appearance satisfactory, it seems desirable to have a metal hood or canopy above the globe, and in this the lamp socket can be placed.

There is, however, one difficulty which presents itself when the socket is so located that at first sight appears a great objection, but, with the design adopted, is claimed to be most effectively overcome. In order to get at the interior of the fixture for cleaning the globe or replacing the lamp, the leads to the socket in the canopy must either be left slack and untidy, or else must be capable of automatic disconnection. A reference to Fig. 3 indicates that a very simple solution of this has been made. The canopy is supported on a spiral tubular stem which also carries the leads, and the stem is attached to a cast tripod at the lower end. To this latter is also attached a male plug carrying suitable electrical connections, and insulated and made mechanically strong with

Fig. 1

Fig. 2

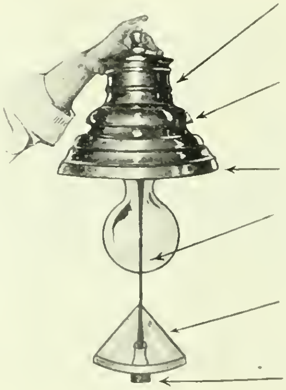


Fig. 3

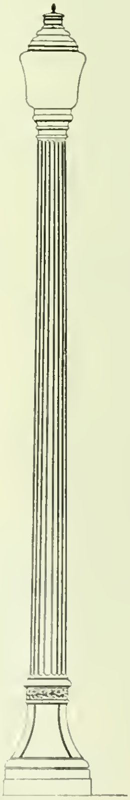


Fig. 4

moulded bakelite. This plug screws into a second mogul socket base centrally located near the bottom of the globe, and the tripod itself rests at its outer edge on a specially designed ring forming part of the top section of the pole. Assuming that the fixture is in position it will be seen that it is only necessary to unscrew the mogul plug by rotating the entire piece illustrated in Fig. 3 for a few turns, in order to withdraw the same from the globe. When separated the lamp can be replaced and the globe cleaned or renewed.

It will be noticed that should the outer globe break, the rest of the unit will remain in position and the light will continue to burn without any other harm being done.

The leads in the detachable section are unaffected by heat and are neatly and permanently connected from the upper socket to the lower plug. All connections are sweated in.

The single steel support was adopted because it could be made as rigid as a more complex design and it was thought better to have one shadow on the house side of the globe than three somewhat smaller ones equally spaced. The stem is, however, carefully flattened along the lamp radial to reduce the shadow formed by it to a minimum and the shadow is only of penumbral formation.

The illuminating characteristics of this unit have been most carefully worked out. Not only is the glassware of special composition, suitable for notrogen lamps, giving a maximum of efficiency and diffusion, but it is specially designed for good distribution. The unit is also fitted with two reflectors, one above and one below the filament, the latter also serving as a neat cover for the lower connections and tripod. These reflectors are so designed to produce practically a uniformly lighted globe, free from shadows and with well directed rays of street illumination.

From the foregoing description it will be appreciated that much careful thought has been expended on these units and the product is in every sense the result of much practical experience with the new lamps and in street lighting problems. Already large installations are being made for lighting the streets of Windsor, Ont., and Outremont, Que.

Restaurant Lighting

Illumination is coming to be recognized more and more as an exact science and what every architect formerly did for himself is now being delegated to specialists in lighting just as important problems in other branches have for many years been worked out by specialists in their respective lines.

As an example of efficient illumination the two photographs reproduced herewith indicate the progress that is being made in one of the many branches of industrial illumination, namely restaurant lighting. Too often our restaurants are lighted according to the fancy of a more or less whimsical landlord with no reference to the requirements of the installation. This is one case, however, where it is good business to have an attractive and at the same time soothing and artistic effect and there is no place where an efficient engineer could be called in to better advantage.

Of the illustrations Fig. 1 is a good example of cove lighting as installed in the Bellevue-Stratford Hotel, Philadelphia. Illumination is by the indirect system and the type of illuminant used is the Linolite. The indirect lighting is supplemented, for effect, by direct lighting from candelabras shown on the tall uprights; the brilliancy of these latter lights is toned down by means of soft brown silk shades. These latter are used partly to relieve the impression of coldness which is sometimes felt in indirect lighting and partly to give restfulness and pleasure to the eye by the soft color effect. Fig. 2 is a photograph of the Cafe Parisian of the Ritz-Carlton Hotel, Philadelphia.

These examples of excellent illumination indicate in a very fair way the stage we have reached in the development of better illumination systems and show that in the majority of cases no single system, either direct, indirect or semi indirect can be arbitrarly employed if efficiency in all its phases is to be considered. A judicious combination of the various systems must be used, the particular installation determining which of the three shall predominate.

Fig. 1

Fig. 2

The installations illustrated herewith were made by the H. W. Johns-Manville Company.

A flat rate of $6 from June 1 to September 7 has been given the summer cottagers at Port Stanley. This service is supplied from the St. Thomas municipal system.

New Companies

The Canadian Hart Accumulator Company, Limited, St. Johns, P.Q., has been incorporated with capital £60,000.

The Import Company, Limited, Toronto, has been incorporated with capital $40,000 to carry on an electrical business.

The Arundel Development Company, Limited, has been incorporated with capital $49,000 and head office Arundel, Que.

The Monarch Refillable Fuse Company, Limited, has been granted a charter with head office Hamilton and capital $40,000.

The Levvy Electrical Company, Limited, has been granted a charter to manufacture and sell electrical appliances; head office Winnipeg; capital $40,000.

The Dealer and Contractor

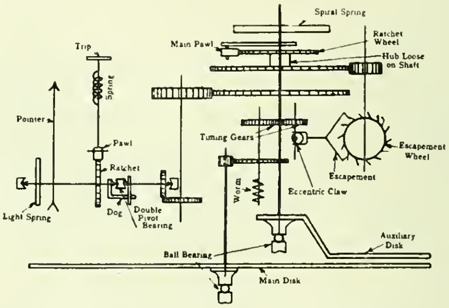
Watthour Demand Meters

For many years electric energy has been sold altogether at a rate of so many cents for kilowatt hour used, the rate depending only on the quantity. Recent years, however, have seen a very decided change in this method of selling and other factors are now given due consideration. The most important of these is the maximum amount of energy called for. There has, therefore, arisen a need for a watt-hour meter to measure this value. A new type of this meter has been recently placed on the market by the Westinghouse Company. This is a single meter that records without the use of a clock mechanism both the kilowatt-hours consumed and the maximum kilowatt demand.

This meter is a combination of an induction watthour meter, an induction wattmeter, and an escapement form of time element. The instrument has a standard Westinghouse type OA watthour meter movement, including electromagnet, permanent magnet and aluminium disk. In addition, it has an auxiliary disk sector supported on a jewel-and-ball bearing so that it can move in the air-gap of the electromagnet, in such a way that it does not interfere with the accuracy of the main disk which always rotates at a speed proportional to the load. The rotation of the auxiliary disk is restrained by a spiral spring, making its final deflection proportional to the watts load. The auxiliary disk with its spring and pointer constitute an indicating watt-meter.

The shaft of the auxiliary disk is geared to an escapement wheel, and the claw restricting this wheel is oscillated by an eccentric on the main shaft. The auxiliary disk therefore advances step by step at a speed determined by the speed of the main watthour meter disk, that is, at a speed proportional to the load. It continues to advance until the spring tension balances the torque produced in the auxiliary disk. The demand mechanism is then in equilibrium and the pointer indicates the watts.

As the total deflection and the rate of deflection of the auxiliary disk vary in direct proportion, the time required to reach the maximum position when any constant load is passed through the instrument is a constant. For example, if a load of 500 watts is applied to a 5-ampere, 100-volt meter with 15-minute time element, the demand mechanism will reach equilibrium at the 500-watt point in 15 minutes. If instead a load of 1,000 watts is applied to the water, the demand mechanism will have to move twice as far, to the 1000-watt point, to reach equilibrium; but the double load will move the watthour disk twice as fast, causing the escapement to allow the demand disk to move twice as fast, and it will cover the double arc in the same time.



Schematic diagram of meter without dial mechanism.

A mathematical analysis of the instrument shows that the deflection for any varying load that does not continue long enough for the instrument to reach equilibrium is equal to the average load during the interval.

The auxiliary disk drives the demand pointer through a dog, and a fine-toothed ratchet and pawl holds the demand pointer in the position of maximum deflection, until released by hand. A second ratchet and pawl allows the auxiliary disk to fall back to equilibrium under its spring tension if the load falls below that corresponding to its position at any moment, but prevents it from advancing except as controlled by the escapement as before.

The maximum demand pointer can be reset instantly by pressing a sealed button on top of the cover. This raises the pawl that holds the pointer in its maximum position and a light spring returns the pointer to zero, or to the position of the auxiliary disk.

The annual report for the year ending March 31, 1911, of the Westinghouse Electric & Manufacturing Company shows gross earnings of $43,733,646. This is a gain of nearly $4,000,000 over the previous year and is the largest on record.

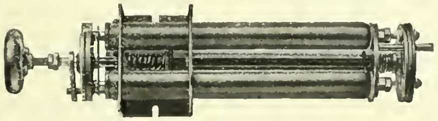
Arrangements are being made for a rejuvenation of the Sons of Jove during the convention of the Canadian Electrical Association, in Montreal.

The "Century" Motor

The popularity of the Century motor is well illustrated in the number of sales made by the Jones & Moore Company, Toronto, during the first ten days of June. These sales totalled between 30 and 40 machines in horse-powers varying from ⅛ up. Jones and Moore advise that they are also doing an excellent business in other lines. Their sales of the last week include a generating set for a moving picture theatre, a rotary converter and a number of large A.C. motors as well as a quantity of d.c. equipment in both motors and generators The purchasers include such well-known names as the Toronto Railway Company, the Gurney Foundry Company, the Zimmer Vacuum Company, the Canadian Buffalo Forge Company, the Elliott Woodworker Company, the Hydro-electric Power Commission of Ontario, the Toronto & York Radial Railway Company, the Toronto Hydro-electric System, the Fletcher Manufacturing Company, etc.

Speed Regulators for Slip Ring Induction Motors

The Allen-Bradley Company of Milwaukee, Wisconsin, has recently developed a speed regulator for slip-ring motors which, it is claimed, has decided advantages over the ordinary wire wound or grid type resistance regulators on the market. The latter machines are generally rated to give a maximum speed reduction of the motor at full load of 50 per cent.; that is, on the first contact on the face plate of the register, the speed of the motor is cut down one-half. Now, assuming that the operating lever was left on the first contact and the load on the above motor reduced to one-half of what it formerly was, it would then only be possible to reduce the speed of the motor 25 per cent., since the speed variation of a slip-ring motor is dependent upon the load of the same and the limited number of contacts might not permit of a sufficient speed reduction. The apparent shortcomings of



the old form of regulator are claimed to have been entirely overcome by the Allen-Bradley Carbon Compression type speed regulating devices. This is made possible by the fact that a resistance range of 100 to 1 can be obtained by means of the carbon compression resister and, therefore, the regulator can always be adjusted by turning the hand wheel to give the desired speed reductions. Of course, this could also be accomplished with the wire-wound or grid type resistance regulator, if the number of contacts and corresponding speed steps were greatly increased; however, the complexity, bulkiness and cost of such a device makes the same prohibitive for general use.

The cut herewith illustrates the simplicity and compactness of the Allen-Bradley regulator. The resistance and corresponding speed variation is obtained by turning the hand wheel which gradually compresses the carbon discs contained in the steel tubes, which are thoroughly insulated from the same. One of such resistance units is supplied for each phase. The applied pressure is absolutely equalized by means of proper mechanism so that the phases are never unbalanced. Another point of advantage claimed over the old wire-wound or grid type resistance is the fact that the resister employed is practically indestructible. It cannot burn out nor is it affected by the action of moisture or corrosive fumes.

Instead of obtaining only as many speed variations as there are contacts on the face plate of the regulator, it is possible to obtain an infinite number of steps with the carbon pile resistance, which is a feature of importance. Any slight turn of the hand wheel effects a change in the speed of the motor, so that the same may be adjusted entirely to operating conditions and held at this point. This method of control also does away with button contacts or renewable segments and consequently all arcing in moving the operating lever from one contact to another is eliminated. This speed regulator is very compact in design and light in weight, although it has a large overload capacity. For 50 per cent. speed reduction it is made in sizes up to 10 h.p. for fan and similar duty, while up to the present time 5 h.p. is as high as these machines are rated for machine duty.

Disc-Stove Chafing-Dish Set

A novel arrangement of a combination disc stove and chafing dish has recently made its appearance. The set is similar to the ordinary alcohol type chafing dish except that it has an electric disc stove, in direct contact with the water pan, instead of an alcohol heater. The complete set consists of a stand, a disc stove, cord, three-heat switch, and attachment plug, a water pan, a food pan, and a cover, as illus-

Fig. 1

trated in Fig. 2. The water pan, the food pan and the cover are the same as used in alcohol heated chafing dishes.

The heater of the disc stove consists of a steel disc inside of which the heating element is sealed and protected from oxidation. A dead-air-space between the heater and the bottom of the stove casing acts as a heat insulator, preventing the loss of heat downwards, so that practically all of the heat is thrown upwards where it is wanted. This arrangement makes the stove very efficient.

An indicating switch controls the temperature. The high heat is ordinarily used to bring the chafing dish to the desired temperature. The low heat will keep water boiling after the boiling point is once reached and is useful for keeping food warm. The medium heat is the highest that is usually wanted for general cooking purposes.

With the feet of the disc stove reversed so that the stove

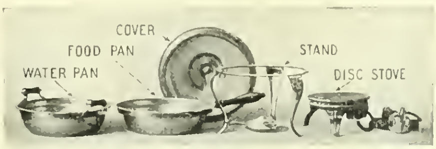


Fig. 2

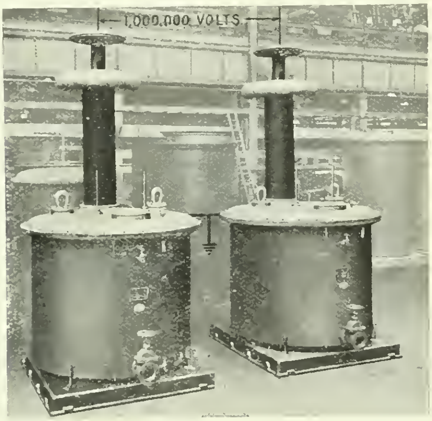
can be suspended from the stand and with the parts assembled as in Fig. 1, the outfit is a chafing dish, capable of cooking anything in it that can be cooked in an alcohol chafing dish. Or, the food pan can be placed directly on the disc stove, omitting the water pan, and as such can be used for any cooking that requires high heat, such as frying, stewing, etc. With the feet inserted in the stove as shown

in Fig. 2, the disc stove can be used separately, for any purpose that a single-burner gas stove can be used for, such as frying, grilling, making coffee, and similar operations. This set is manufactured by the Westinghouse Electric and Manufacturing Company.

Large Testing Transformers

The accompanying illustration shows two testing transformers, having a normal rating of 360,000 volts continuously, and 500,000 volts for short periods. These transformers were recently furnished the Inawashiro Hydro-Electric Power Company of Japan, one to be installed in the generating station on the Nippashi River at the outlet of Lake Inawashiro, about 145 miles from Tokio; the other in the receiving sub-station at Tokio, where they will be used for testing transmission lines and apparatus in the stations.

The design features of interest in these transformers are the arrangement of the windings to give distributed static



fields; the use of condenser terminals to give distributed stresses from terminals to ground; and the terminal "hat" to distribute stresses from terminal tip to ground. The transformers are 19 feet high from base to top of terminal and the tanks are 9 feet high and 9 feet diameter. One high-tension terminal of each transformer is grounded to the core and case, the other being brought out as shown in the illustration. By connecting the cases of the two transformers as shown one million volts can be developed between the two high tension terminals.

These transformers were built by the Westinghouse Electric & Manufacturing Company.

The Mica Industry

One of the best known mica dealers in Canada is Mr. S. O. Fillion, of Ottawa. Mr. Fillion has been closely associated with the mica industry for the past fifteen years in Canada, the United States and in India, the three chief countries in which mica is produced. He spent four years, from 1905 to 1909, in the mica fields of Bengal and Madras and is considered one of the most expert dealers in the mica business. He founded his present business in 1909 and perhaps the best evidence of the service rendered has been the rapid growth of this business. In addition to his operations in Canadian Amber mica he has his own factory in Bengal whence his supplies of India Ruby mica are obtained direct from the mines and are specially prepared to suit the requirements of the trade in this country both in electrical mica and in stove mica. Hitherto it had been necessary for stove manufacturers to obtain their stove mica from United States dealers. Canadian manufacturers are now able to obtain through Mr. Fillion all qualities and grades in both Canadian Amber and India Ruby mica.

Interstate Electric Novelty Company of Canada

The Interstate Electric Novelty Company, Limited, of Canada, announce that they have opened an office, stock and show rooms in the Nicholls Building, 220 King Street West, Toronto. This Canadian company has acquired the sole rights for manufacturing and selling the well known Franco products of flash-lights, lamps and batteries and other electrical novelties. The parent company in the United States are just placing on the market some improvements in electric flash-lights in which the connections are so arranged that they are claimed to be absolutely unbreakable and not subject to short circuit. It is said that these flash-lights can be placed in the "kit" with the other tools without any danger of wearing out the battery.

B. S. Barnard & Co.

B. S. Barnard & Company, of 50 Church Street, New York, announce that they have recently taken on a new and improved line of conduit specialties such as tools for removing obstructions in ducts, conduit rods, wrappers, plugs, cable hangers, etc., as well as tools specially made of manganese steel. Mr. Barnard is generally known as the pioneer in underground conduit construction and though his company will still continue to be known particularly as the manufacturers of clay conduits, his experience should be a sufficient guarantee to the trade that in undertaking this side line the tools manufactured will represent the best in material and in labor economy that can be produced. Mr. Barnard's connection with the Clermont Sewer Pipe Company as vice-president for the last four years is almost as well known as the name Clermont itself, which is to be found on many millions of feet of conduit along the streets of the principal cities of Canada during the progress of installation of the last few years. Among the more prominent users may be mentioned the Bell Telephone Company of Canada who have placed their orders through Mr. Barnard for the past 15 years, the Montreal Light, Heat & Power Company, the Hydro-electric System of Toronto, the city of Hamilton, the corporation of the city of Westmount and many others. It is understood that Mr. Barnard has in mind a Canadian plant to manufacture a superior quality of clay conduits.

Though Premier Borden has intimated that there will be no government aid to Ontario's hydro- electric radial railway system this session the municipalities are still hopeful and will submit by-laws in the near future authorizing the construction of these railways conditional on a government grant being received.

Obituary

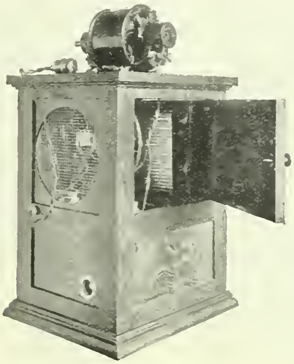
The Ferranti Electrical Company of Canada have suffered a severe loss in the death of their president, Mr. R. Bruce Anderson, who was a passenger on the ill-fated Empress of Ireland. Mr. Anderson was also very prominently connected with the British interests associated with the Canadian company, being managing director of Ferranti, Limited, and a director of the Bruce Peebles Company, as well as being chairman of the British Electrical and Allied Manufacturers' Association, and a member of the council of the Institution of Electrical Engineers.

The death occurred on May 27 of Sir Joseph Wilson Swan, the first Englishman to invent an incandescent lamp and probably the first in the world. This was in 1879.

Ozone Purifier

The illustration herewith shows a type of ozone air purifier made by the Neel-Armstrong Company, Akron, Ohio. This machine is being used successfully in moving picture theatres, toilet rooms of public buildings, etc.; also widely in refrigerators of abattoirs and meat markets where a saving in ice is claimed as well as an improvement in the refrigeration.

Tests by the city chemists of Akron in the Waldorf



Moving Picture Theatre show the following results obtained by the installation of one of these machines:—

Examination of Air	Jan. 23rd 7 p.m. No Ozone	Jan. 24th 5 p.m. With Ozone	Reduction in Colonies of Bacteria
Carbon Dioxide, in parts per 10,000	35	30	—
Oxygen, per cent.	19.4	20.1	—
Colonies of bacteria on agar-culture plates:			
10 min. exposure	300	17	95% reduction
20 min. exposure	innumerable	80	90% or more reduction

The outfit illustrated is equipped with a Robbins & Myers Rotary Transformer for converting direct current into alternating current for the transformer which steps the voltage up to the high pressures required for this service. A "Standard" fan also manufactured by The Robbins & Myers Company is mounted within the transformer case to blow the ozone out into the room.

Lightning Arrester Hangers

Special types of lightning arrester hangers have been placed on the market by the Electric Service Supplies Company for use in installing their Garton-Daniels lightning arresters. Heretofore operating men have made use of small cleats to fasten these arresters to the cross arms or have devised other means to meet unusual conditions. With careful consideration of the many varying conditions governing the

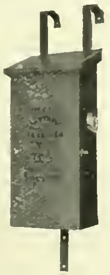


Fig. 1.

Fig. 2.

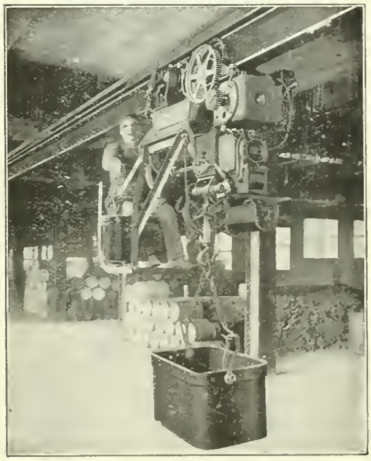
installation of lightning arresters, these hangers were designed, (a) to furnish a hanger which would place them substantially, and (b) to make their installation easy.

Style C hanger (Fig. 1) is for installations between two cross-arms; the upper part of the supports being bent to fit over the upper arm. It will be seen that it is a comparatively easy task to place the arrester when it can thus be secured to the cross-arms without having to be held. This is also true of Style B hanger (Fig. 2) but this style being for single arm installation does not require a lower support.

Electric Hoists

In order to satisfy the demand for efficient lifting and carrying devices to fill the gap between the handchain block and the large travelling crane, the Sprague Electric Works have designed a complete line of electric hoists in capacities from one-half to six tons. The motors and gears are entirely enclosed for protection against dust and moisture and the hoists can be used out of doors without any housing. They may be mounted on a plain hand geared or motor-driven trolley carriage as conditions require and the small I-beam track, which provides the best facilities for moving the loads, may be cheaply installed.

The variety of conditions under which these electric hoists can be profitably used is legion. For lifting small castings and forgings in a machine shop, to handle coal and ashes in boiler rooms, for carrying rolls of paper in a newspaper press room, the smaller styles are admirably adapted. The larger hoists are equally efficient for heavier loads. In



transporting material in bulk some kind of carrier, crate, or bucket is necessary if it is desired to utilize the machine to the best advantage. The accompanying cut shows how a bucket can be carried on the hoist hook. Another successful application is in connection with the grab buckets for delivering coal and ore.

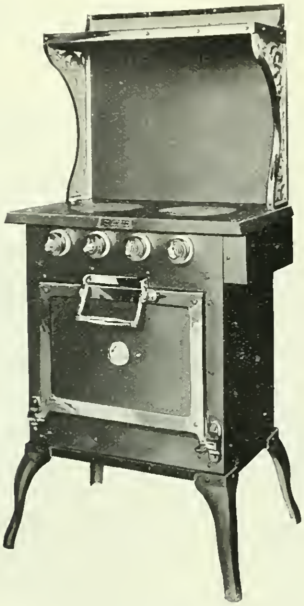
License Electrical Contractors

An ordinance has been passed by the city commissioners of Denver creating a board of electrical examiners. This board is to consist of three members, the city electrician being, ex-officio chairman. It will also include one electrical contractor and one journeyman electrician. These three men shall have the power and authority to examine every person engaged in the electrical business, whether employer or employee, helpers excepted. After the person passes the examination the board will issue a certificate of qualification upon the payment of 50 cents, and this certificate will be renewed yearly without examination.

A New Electric Range

A very attractive electric range is being placed on the market by the National Electric Heating Company, Toronto. These ranges will be manufactured in two models. Model A2 will have two 8-inch discs and a cooking oven in which there is also installed a broiler. This model is illustrated herewith. Each of the 8-inch discs draws 1,000 watts and the broiler and oven elements 1,000 watts each. All the elements have a three heat attachment—full, medium and low, the low consuming approximately one-quarter of the full heat. Model A4 will have two 8-inch discs and two 6-inch discs. The oven will be somewhat larger and both oven and broiler elements will draw 1,200 watts.

These ranges are very substantially constructed and impress one with the idea that they are made for everyday service.

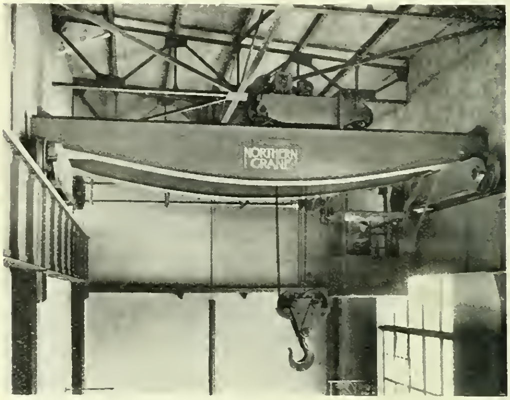


Construction is of heavy sheet polished plate steel thoroughly reinforced with angle iron frames. Nickel plated trimmings make a very attractive finish. The oven is aluminium lined, double seamed and the inner surface is of special insulating material impervious to gases. Both the body of the oven and the door are heavily insulated and the oven practically air-tight.

As shown in the illustration the elements are enclosed, which adds both to the efficiency and the life of these units. In practice it is found that the heat retaining properties of the units are such that the current may be turned off at least one-half of the time during cooking without delaying the operation in any degree whatever. Where a low heat is required for a considerable length of time the second or third heat is sufficient and equally economical. It will be noted also that the elements in the top of the stove are practically flush which enables the entire surface of the elements to be used for heating purposes. The oven unit is also installed flush in the same way.

A Large Crane

The photograph herewith is that of a 50-ton crane in the plant of the Canadian Light & Power Company. This crane has a span of 26 ft. 7 in.; a lifting capacity of 50 tons; a height of lift of 25 ft., and is of Northern Type "E" standard design, manufactured by the Northern Crane Works, Limited, Walkerville, Ont. The gearing is all steel with cut teeth; drum is grooved to take entire length of hoisting rope without overlapping and for a central plumb lift. The trolley is of their patented type "E" construction, having all hoisting gears enclosed, non-overhung, with bronze bearings, all bearings capped.



Trolley travel gearing is of similar design. Crane is equipped with an automatic limit stop for stopping block at top of lift, also with both mechanical and electrical brakes and with bridge foot brake. Girders are of the box form of very heavy construction. Trucks are MCB type with capped bronze bearings of the waste pocket type. Block is of special construction to insure high life. Sheaves have bronze bearings. Hook is forged and annealed with the head resting on ball bearings and is arranged to both swing and turn. Crane is constructed to carry a full load of 50 tons, with a minimum safety factor of 5. Footwalk extends the entire length of bridge, allowing access to bearings on the trolley when in any position on the bridge. Truck and trolley wheels are of steel with machined treads. The construction of this crane adapts it especially to power station service. The enclosing of the gears insures the longest possible wear, durability, safety and the exclusion of all dirt and dust from the working parts and the most thorough lubrication. This construction also prevents the dripping of oil and grease from the crane over the machinery of the power station.

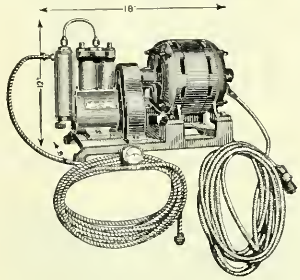
Series Nitrogen Street Lighting

One of the most interesting features of the electrical exhibits at the National Electric Light Association Convention was the new type Westinghouse nitrogen filled lamp which we understand has just been adopted by the sanitary district of Chicago for lighting the streets of the residential district of that city. The fixture when complete is similar in appearance to an arc lamp, each unit including an auto transformer. This transformer is designed to operate a 300 watt, 600 candle power, 20 ampere lamp from a 6.6 ampere or 10 ampere, 60 cycle constant current circuit. It is specially designed and arranged to protect a lamp from over voltage in case of line surges and severe grounds. This will be the first large installation of series nitrogen filled incandescents for street lighting purposes.

The Railway & Industrial Engineering Company, Pittsburgh, Pa., announce that they have moved their factory and main office to Greensburg, Pa., and that their manufacturing facilities have been materially increased.

An Electric Garage Pump

The Hartford Machine Screw Company have placed on the market an electric pump for private garages. The equipment consists of a two-cylinder pump driven by a small electric motor, all mounted on one frame. It is claimed this pump



will completely inflate a 37 x 5 tire to 90 lbs. pressure in less than three minutes. The motor used is a small General Electric type. The equipment is illustrated herewith.

A New Elevator Motor

The Westinghouse Electric & Manufacturing Company has just announced that it is placing on the market an alternating-current squirrel-cage elevator motor of new design. The special features claimed for this motor are great mechanical strength, quiet operation, extreme reliability, and excellent performance characteristics. It requires only a simple switch without resistance and is started by being thrown directly on the line. It starts with high torque, so that the car is quickly but smoothly accelerated. Only a moderate starting current is drawn from the line.

These motors are made in sizes from 3 to 20 h.p., for 2 and 3 phase, 25 and 60 cycle circuits of 220, 440 and 550 volts.

The National Electric Heating Company, Limited, of Toronto, announce to the trade that Mr. F. C. Carman, late of the Canadian Carbon Company, Limited, is now on their sales staff. Mr. Carman will cover Western Canada.

Trade Publications

Strain Insulators—Folder issued by the Ohio Brass Company describing their new type X strain insulators.

Weather Proof Sockets—Folder issued by Pass & Seymour, Inc., describing the Shurlok weather proof socket.

Electric Hoists—Bulletin issued by the Canadian General Electric Company describing and illustrating Sprague electric hoists.

Refrigeration—Booklet entitled "Practical Talk on Refrigeration" issued by the United Ice Improvement Company, New York.

Trolley Catcher—The Electric Service Supplies Company have issued an attractive folder descriptive of Keystone Trolley Catchers.

Cut-out Hangers—Folder issued by the Thompson Electric Company, Cleveland, describing various types of single and double cord hangers.

Cooking Breakfast at the Table—Folder issued by the Westinghouse Company being a one act, true-to-life sketch of the modern breakfast prepared by electric devices on the breakfast table.

The Out Door Sub-station—Bulletin No. 13 issued by the Delta-Star Electric Company, Chicago, describing and illustrating their steel tower sub-stations complete with jib cranes and transformer table.

Automobile Lamps—Small catalogue issued by the Canadian General Electric Company entitled "Mazda Automobile Lamps for 1913 and 1914 Cars"; also pamphlet describing AB Trumpet electric horns for motor cars.

Street Lighting—Booklet issued by the Canadian General Electric Company entitled "The attractive lighting of business streets." The booklet consists chiefly of typical lighting installations made by this company.

Panel Boards, Cabinets, etc.—Catalogue No. 21 issued by the Frank Adam Electric Company, St. Louis, Mo., describing and illustrating panel boards, cabinets, switches, switchboards, etc., manufactured by this company.

Annual Report—The Manitoba Public Utilities Commission have just issued their second annual report which covers the year ending November 30, 1913. The report covers 180 pages and deals with the various phases of the electrical situation practically all over the province.

Industrial Control—Bulletin issued by the Canadian General Electric Company describing push button control for motor drive in industrial plants. This bulletin is well illustrated and contains a number of valuable suggestions regarding "safety first" devices in industrial work.

Steel Tower Sub-Stations:—The Delta-Star Electric Company, Chicago, are distributing a bulletin devoted to a description of their new type steel tower outdoor high tension sub-stations. The bulletin includes 36 illustrations and will be valuable to those interested in this line of work."

Portable Instruments—Booklet issued by the Wagner Electric Manufacturing Company, St. Louis, entitled "A Manual of Electric Testing." This bulletin is very completely illustrated and in addition to minute explanations of the Wagner instruments includes a quantity of information, with line diagrams, on electric testing.

Textile Mills—No. 7 of the Textile Quarterly issued by the Westinghouse Electric & Manufacturing Company, describing power plants for textile mills. The Westinghouse Company have also issued Catalogue Section DS 845 which describes and illustrates porcelain and glass insulators for transmission lines up to 110,000 volts.

Electric Vehicles—The General Vehicle Company, Long Island City, N.Y., have issued a booklet entitled "Co-operative Advertising for Central Stations" in which they outline their system of assisting central stations to advertise electric vehicles at minimum cost. The same company are distributing a bulletin entitled "Good Store Service."

Rail Bonds.—The Electric Service Supplies Company have issued the 1914 edition of their catalog on Protected Rail Bonds and Appliances. The illustrations, besides showing the many different types of bonds, also show clearly the value of proper installation, the importance of accurate testing apparatus and the use of bond compressors. The section of the catalog describing and illustrating the methods of installing rail bonds enters into the subject in detail and indicates graphically the importance of assuring a perfect moisture proof contact between the bond and the rail.

Electric Cooking—The Hughes Electric Heating Company have issued a folder explaining the extent to which their electric ranges are used in Winnipeg. Apparently these ranges are especially favored in apartment houses, as, in seven apartment houses recently built there is a total of 95 electric ranges installed. Altogether it is stated that there are 2,500 Hughes ranges installed in Winnipeg. The folder also describes the new type of heating unit being installed in their latest range. This is a very quick heating unit designed for use where some item of cooking is required in a great hurry.

Current News and Notes

Brandon, Man.

Mayor Hughes is a strong advocate of the scheme for acquiring power from Winnipeg by a high tension transmission line by way of Portage La Prairie. The figures of cost to Brandon total approximately $310,000, made up of $12,650 (which is half cost from Winnipeg to Portage and $297,903 (being cost of line from Portage to Brandon with the necessary transforming and switching equipment). Mayor Hughes calculates that the total annual cost to Brandon would be $91,386 for 2500 h.p., which is made up of $50,000 for power (being 2500 h.p. at a cost of $20 per h.p.) and $41,386, depreciation, operating expenses, etc.

Brampton, Ont.

A contract has been awarded to the Northern Electric Company for the installation of a fire alarm system for the town of Brampton.

Broadview, Sask.

The British Canadian Engineering & Supply Company have obtained a contract for supplying the town of Broadview, Sask., with a Ruston-Proctor gas engine and producer plant of 72 brake h.p. and 50 kw. alternator, together with switchboard, exciter and all electrical equipment, both inside and outside the power house.

Cobalt, Ont.

The first of the two units being installed for the Northern Ontario Light & Power Company at Fountain Falls is now operating. This is a 1500 h.p. unit, Swedish General Electric manufacture. Fountain Falls is situated on the Montreal River, some two miles north of Hound Chutes.

Edmonton, Alta.

The city council have awarded to Escher, Wyss & Company a contract for the supply of a 6,000 kw. turbo-generator.

After first turning down the proposal to increase the street railway fare to 5c straight the city council have approved this recommendation and beginning May 17 this rate was established. The one exception is from 6 a.m. to 8 a.m., when tickets are sold at eight for 25c. The increase in rates has been necessary as the result of continued deficits in the railway department.

The generating equipment installed by the municipality during the past year comprises four Babcock & Wilcox boilers 4,870 sq. ft. heating surface, with chain grates and super-heaters; one 750 kw. Belliss-Siemens traction set complete with condenser; one 2000 Willans-Siemens turbo-alternator with condenser; one motor-driven ejector draft plant and stack of inverted funnel type, said to be the only one operating in Canada; one Paterson water softening, de-oiling and purifying plant, capacity 8,000 imperial gallons per hour; two Wier boiler feed pumps, each 7,500 imperial gallons per hour; one Venturi meter for boiler feed; one Avery automatic coal scale.

Two sub-stations were erected for traction purposes and are each equipped with a 500 kw. motor-generator. Power is supplied to these sub-stations at 6,600 volts, 3 phase, 60 cycles, by cable.

The producer-gas plant recently installed, as indicated by the recent report of the power house superintendent is manufacturing power at a cost, including all fixed charges, of 1.613c per kw.h. Power is supplied to the electric department at 3.345c per kw.h. and to the street railway department at 2.282c per kw.h. The power consumption of the electric light department was 13,490,590 kw.h. and of the street railway department 9,806,887 kw.h.

A representative of the consulting engineering firm of Porter and Sanderson of San Francisco and New York, was in Edmonton on the first of June and approached the city council with a proposal to develop water power on one of the numerous streams originating in the rocky mountains, a distance of 200 miles west of Edmonton. The offer of the United Colliery, Limited, of Winnipeg and Edmonton, to supply electrical energy to the city at three-fifths of a cent per kilowatt-hour plus twelve dollars per year per horsepower, was adversely reported on by the commissioner of operation and turned down by the council.

The Commissioner of Telephone Operation recommended an increase in telephone rates as follows.—Business wall telephone from $30 to $45; extra per year for desk telephone, $3; residence wall telephone from $20 to $24; extra per year for desk telephone, $3. This increase in rates to take effect on the first of July. The recommendation was adopted with the exception of the residence rate which remains unchanged.

Estevan, Sask.

Tenders are called for the supply of two 250 kw., 2,300 volt, 3-phase, 60-cycle generators for direct connection to producer gas engines; also one 500 kw., 2,300 volt, 3-phase, 60-cycle generator for direct connection to producer engine. The equipment will also include two exciters.

Granby, Que.

Messrs. Grant, Campbell and Company are constructing an extension of the Montreal & Southern Counties Railway line from St. Cesaire to Granby, P.Q.

Hamilton, Ont.

This city will invite some 200 guests to witness the inaugural turning on of the new nitrogen street lighting system, on July 1.

Kincardine, Ont.

A by-law will be submitted on June 25 to raise $3,500 for the purpose of changing over from an arc to an incandescent lighting system.

Lacombe, Alta.

The town of Lacombe have placed an order with the Canadian General Electric Company for a 100 kw. generator, 2,400 volts, 60-cycle, 3-phase, 600 r.p.m. This is to replace a 60 kw. machine as owing to the increase in power consumers it was found necessary to get a machine of larger capacity. Tenders for a 100 h.p. horizontal return tubular boiler working at 125 lbs. pressure have also been called. Lacombe has a water power which is now developing 60 kw. but the dam is getting old, and will have to be replaced by a concrete dam which will cost $25,000. Under the present conditions they are undecided whether it would not be advisable to give up this power altogether in favor of steam, as water is available for only eight months in the year.

Medicine Hat, Alta.

Magnetite arc lamps are being tried out on one of the streets of Medicine Hat. These are to be compared with gas arc lights placed on another street.

Montreal, Que.

There is a probability that the city will establish an electrical inspection department, to carry out work which is

now done by the Canadian Fire Underwriters' Association. The city have the necessary powers under the charter. It is understood that the city of Westmount also have under consideration establishing a similar department.

The gross revenue of the Montreal Light, Heat and Power Company for the fiscal year ended April 30, totalled $6,245,697, an increase of $736,141, while the net income, after paying fixed charges, was $2,399,268. Operating expenses rose from 42.3 per cent. to 44.5 per cent., due to advanced prices of raw materials. Mr. H. S. Holt, the president, stated that the steam reserve plant for the electric department at La Salle is equipped for 25,000 h.p. and designed for ultimately 50,000. The new steel pole transmission line between Cedars Rapids and Montreal is under way and will be completed simultaneously with the hydro-electric development of the Cedars Rapids Manufacturing & Power Company, with which the company has contracted for part of its power supply. It has been decided to reduce electric and gas rates, which means that electric light now costs the consumer about half the price it did seven years ago. The reduction announced affects net rates only. The gross rate will remain at 8 cents per kilowatt hour, but the discount is increased to 25 per cent., making the net rate 6 cents. This only applies to overhead service, the president stating that they cannot reduce the electric lighting rate for underground service; in fact the great difference in costs for this class of service as demonstrated by the cost of the new civic conduits and equipment will render it necessary to establish some fair differential to offset the additional cost entailed, and as the civic conduit system is extended into new territory, the consumers there will be required to pay increased rates for service.

Mr. George R. Tooke is now associated with Mr. Irving Smith, 809 Unity Building, Montreal. Mr. Smith represents several manufacturers of electrical specialties.

At the annual meeting of the Montreal Electrical Society the following officers were elected: President, J. N. Mochon; vice-president, L. E. Hamilton; secretary, J. C. Bray; treasurer, E. L. Brewer; board—contracting, W. H. Tees; commercial, T. R. Campbell; manufacturing, R. McIllwraith; traction, P. T. Davies. The report and accounts submitted by Mr. J. C. Bray and Mr. W. H. Tees respectively stated that there were 266 members and that the receipts were over $1,100. Notice of amendments to the constitution relating to fees and membership were given by Mr. Hamilton. Votes of thanks were passed to the retiring officers.

After prolonged negotiations the city of Montreal have made new arrangements with the Montreal Light, Heat and Power Company for the lighting of those streets on which underground conduits have been laid. This involves the disappearance of the existing poles, and the overhead arc lamps, the latter being replaced with ornamental standards each surmounted by a single magnetite arc lamp. The agreement with the city is for six years, and the price per lamp is $72.70 per 6.5 ampere magnetite arc lamp and $63.15 per 4 amp. magnetite arc lamp. Provision is also made for tungsten lighting, the prices being $23 for 80 c.p. and $16 for 40 c.p. lights. The city will supply the lights, standards, and cables, the equipment costing $39,500, and according to Mr. Arthur Parent, the civic superintendent of lighting, this will mean an additional charge of about $20 per magnetite arc lamp. As a beginning 200 lamps will be installed on St. Catherine and Bleury streets.

Ottawa, Ont.

The National Joint Commission have given their final order of approval to the Michigan Northern Power Company and the Algoma Steel Corporation for the diversion of water for power purposes from St. Marys River at Sault Ste. Marie. A diversion of 30,000 cu. ft. per second on each side of the river is allowed and this, it is estimated, will produce in the neighborhood of 100,000 h.p.

Owen Sound, Ont.

A new system of street lighting is being designed which is calculated to serve the purpose of better illumination until the advent of hydro-electric power, when the system will, it is said, be entirely remodelled.

Prince Rupert, B.C.

An order has just been received by the Herbert Morris Crane & Hoist Company through their agents in Vancouver, Messrs. Waddy & Young, for a 10-ton hand operated overhead travelling crane, fitted with Morris roller bearings to the main travelling motion. The new power house is well under way and is expected to be in full operation before the autumn.

Redcliff, Alta.

A by-law was recently carried authorizing the expenditure of $90,000 for extensions to the water and light services of the town.

Rouleau, Sask.

The Crescent Rural Telephone Company, Limited, have awarded a contract to Ross & Hayne, Regina, for the supply of material and the construction of their telephone system.

Sault Ste. Marie, Ont.

A daily weather bulletin for the Great Lakes is now being sent out from the radio station at Radio, Va., according to an agreement just arrived at between the United States Weather Bureau and the United States Naval Radio Service. This bulletin is sent out in two parts. The first consists of code letters and figures describing the points along the Great Lakes. The second part of the bulletin is a special forecast of the winds that will probably be encountered on the lakes. This is distributed to shipmasters on the Great Lakes by the Naval Radio Service during the season of lake navigation—usually from about April 15 to December 10—in the same way that weather conditions for the North Atlantic Ocean and the Gulf of Mexico are sent out. The latter service was begun in July of last year. It proved popular and the Weather Bureau was encouraged to extend the service to the Great Lakes.

Saskatoon, Sask.

A by-law was recently passed authorizing the expenditure of $200,000 for electric equipment and extensions.

Tenders are called for a 600 kw. rotary converter; also a 75 kw. motor-driven exciter, two 4,000,000 gallon motor-driven centrifugal pumps; three 400 kw. transformers together with the necessary switchboards, cables, etc.

Simcoe, Ont.

A by-law will be submitted authorizing the expenditure of $40,000 for the construction of a hydro-electric distribution system.

Stratford, Ont.

Contracts have been awarded in connection with extensions to the municipal street lighting system. The Hydro-electric Power Commission of Ontario have the work in hand.

Tavistock, Ont.

A by-law was recently carried authorizing the council to proceed with the installation of a hydro-electric distribution system.

Toronto, Ont.

The date for the vote on the hydro-electric radials throughout the Markham, Port Perry and Uxbridge district has been set as September 21.

The Hydro-electric Power Commission of Ontario have purchased a site on University Avenue, on which a building will be erected for the executive offices.

Electrical News
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The C. E. A. Convention

It can easily be said that the entertainment provided for the delegates to the 24th Annual Convention of the Canadian Electrical Association, by the Montreal members, excelled anything that has been provided in the past at these conventions. Montreal electrical men, at all times noted for their hospitality, made a special effort on this occasion to send the delegates away satisfied that they had crowded the greatest possible amount of entertainment into their three days' visit.

On Wednesday morning, the first day of the Convention, a general reception was held in the ballroom of the Ritz-Carlton, at which the delegates and their wives and friends were welcomed by the officials of the city of Montreal. At eleven o'clock the ladies were taken in automobiles to the Country Club, one of the most beautifully situated and best appointed clubs in the Dominion, where they were entertained to luncheon. Leaving the Country Club they proceeded for an early afternoon "Scotch" tea to the steamer "Saturnia," one of the Donaldson liners, where they were courteously received and lavishly entertained. An hour later the party boarded the steamer "Ascania" of the Cunard line, and again every possible consideration for the comfort of the delegates was shown. During the afternoon a life-saving demonstration and a fancy swimming and diving contest including a number of interesting races, was witnessed from the steamers by the delighted visitors.

Returning to the Ritz Carlton, dinner was followed at 8.30 by a bridge and five hundred party for the ladies, with music and refreshments, and suitable prizes for the winners and near-winners. At nine o'clock one of the most successful smoking concerts in the history of the Association was held in the basement for the visiting delegates. The variety of the entertainment and the versatility of the entertainers deserve special mention, and delighted the delegates well into the small hours.

Thursday showed no abatement in the efforts of the entertainment committee to provide a pleasurable time for the ladies. Visits were made starting at ten a.m. to points of interest throughout the city, including the Art Gallery (said to be the finest in Canada), the Bell Telephone Exchange, the mountain top (representing a magnificent natural park of some four hundred acres overlooking the city),

S.S. Saturnia, Donaldson Line.

McGill University, etc. In the afternoon the gentlemen were given a holiday, and at three o'clock everybody proceeded first by the Montreal Tramway system to Lachine, and then by special steamer "Duchess of York" through the Lachine Rapids, one of the most beautiful and thrilling trips on the St. Lawrence River. A circuit was then made of the Montreal Harbor, and the party finally disembarked at the Vickers Dry Dock, a magnificent work at present under construction. After a minute inspection of this dock, the

Dry Dock "Duke of Connaught," Maisonneuve.

party proceeded again by the Montreal Tramway cars to Dominion Park where an open air dinner was served from 7.30 to 10. Return to the Ritz Carlton was made by street car at a comparatively early hour.

In this connection a few remarks on the new dry dock will be of interest. The shipbuilding and repair works of Canadian Vickers Limited, promises to be one of Montreal's

most important industries. This very large plant is at present under construction at Maisonneuve, including a number of shops necessary to the building and repairing of vessels. As a beginning to the enterprise, the dry dock "Duke of Connaught" was built in England and recently brought by tugs to this country. The combined length is 600 feet over all, with a exterior width of 135 feet, and a clear inside

The Tomb of the Wire.

width of 100 feet. This dock is so built as to be separable lengthwise into three complete parts, so that one, two or three of the sections can be utilized according to the size of the vessel to be docked.

Practically all the equipment, when installed, will be electrically operated. That portion of the works in operation is equipped with individual and grouped motors with current supplied by the Montreal Light, Heat and Power Company at 11,000 volts. Ordinarily, current will be provided in the dry dock from the shore, but when the dock is away from the basin, provision is made for the generation of a supply by steam-driven units. A special power house is at present under construction which will include transformers, rotary converters, etc. The electrical equipment is being manufactured by Vickers Limited, Sheffield, and by the Electric & Ordnance Accessories Limited, Birmingham. The lighting throughout will probably be by mercury vapor lamps of a capacity of 3,500 candle-power each.

On Friday morning the ladies were left free to entertain themselves along St. Catherine Street, Montreal's famed shopping centre. In the afternoon the cars of the Montreal and Southern Counties Railway were placed at the delegates' disposal and a delightful trip it was to Chambly and return in time for afternoon tea at the Ritz Carlton. During the afternoon souvenirs of the Convention were presented to the ladies which consisted of a piece of silver, with the famous Henry Birks stamp. At 7.30 the delegates were entertained at the theatre party at the Orpheum Theatre, and afterwards an informal dance was held at the Ritz Carlton.

An interesting contribution to the entertainment proceedings was made by the G. M. Gest Company who are constructing the elaborate underground system in Montreal. This was designated the "Tomb of the Wire," and took the form of an artistic one-storey pagoda erected over one of the transformer pockets are forming an entrance to the pocket. The underground enclosure was exquisitely decorated in tapestries, and sweet music, discoursed from an unseen source, delighted the visitors while they partook of the hospitable refreshments supplied by Mr. Stannard. This item constituted one of the most interesting and instructive features of a most complete three days' entertainment programme. The illustration shows Dr. Herdt (on the left), Chairman of the Electrical Commission of Montreal, and Mr. D. B. MacIntyre, Superintendent of Construction for the Commission.

Congratulations are certainly due Mr. Lawford Grant, the Chairman of the Entertainment Committee, whose activity and enthusiasm were in evidence every minute of the three days of the Convention. Scarcely less enthusiasm however was shown by Mr. R. M. Wilson, Mr. Julian C. Smith, Mr. P. T. Davies and many other well-known electrical men of Montreal, who gave themselves up unreservedly to assure the visitors a good time.

Convention Headquarters Ritz-Carlton, Montreal.

The Twenty-fourth C. E. A. Convention

At the Ritz-Carlton, Montreal, one of the Most Successful in the History of the Association —Over 400 Delegates—Resume of Papers program and Discussions

The twenty-fourth Annual Convention of the Canadian Electrical Association held in Montreal at the Ritz Carlton on June 24th, 25th and 26th was one of the most successful in the history of the Association. Something over four hundred delegates registered and the quality of the papers presented during the three days' programme was of a particularly excellent and interesting order. As far as possible every phase of the electrical industry was covered. As is almost inevitable, the time alotted for discussion was insufficient, but with what little time the delegates had at their disposal, some very interesting points were brought forward. Below we give a brief resume of the different papers and in a number of cases, the discussions which followed them. The report will continued in our next issue.

The action of the Montreal Tramways Company, and of the Montreal and Southern Counties Company in placing their street cars at the disposal of the visiting delegates was highly appreciated. The visitors are also under great obligation to the Cunard and Donaldson steamship lines for their hospitality during one of the afternoons, and to the Lachine Transportation Company, the Vickers Limited, and the Dominion Park Company for their continued hospitality on the second day of the Convention.

A number of interesting souvenirs were presented, including a paper weight representing a tungsten lamp by the Canadian Laco-Philips Company; a tobacco pouch in the form of a rubber heel, by the Walpole Rubber Company; a lead pencil by the Robert Reford Company on which were inscribed the words "Let this remind you to use the Cunard, Donaldson and Thomson lines for both passenger and freight service"; and the special Convention souvenir which took the form of a silver bottle opener. This latter was suitably inscribed, drawing attention to the date and location of the convention.

MODERN SWITCHING EQUIPMEMT

By L. B. Chubbuck

The speaker showed a large number of lantern slides representing various switching equipments installed in a number of well-known Canadian companies. As the slides were presented Mr. Chubbuck pointed out various items of interest in the switchboard design and in the particular types of equipment installed.

LEGAL ASPECT OF INTERFERENCE BETWEEN SYSTEMS OF ELECTRICAL COMPANIES

By G. H. Montgomery, K. C.

This paper was practically a resume of all the past Canadian legal decisions affecting electrical companies in their relations to one another or to the municipalities they serve, and is, we believe, the first attempt to classify such decisions. In this connection the paper is of practical interest to every operating company as it will indicate the attitude of the judiciary during the past few years in the interpretation of the various forms of franchise agreement and will thus suggest the probable interpretations of the future.

Discussion

In the discussion which followed, Mr. McDougall outlined the decision which had been made in connection with the T. E. L. Company and the City of Toronto, and described the company's recent victory before the Privy Council, where their rights to go into all the newly annexed parts of the city have been firmly established.

Mr. Dion described conditions in the City of Ottawa where there is a satisfactory working arrangement between the municipality and the company to use the same transmission poles. Mr. Chambers described the legal fight which he had recently gone through with the municipality of the town of Truro. The town had been granted an injunction to prevent certain work being carried on by the company but had dropped the matter at that point. Mr. Bird made the suggestion that the legislative committee of the association should be instructed to collect and file all legal information of this sort respecting Canadian private companies; this brought a remark from the president that it had already been decided by the general committee to follow this matter up.

SAFETY FIRST

By J. F. H. Wyse

Mr. Wise describes in a very interesting way the historical growth of the now world-wide movement towards the preservation from accident of the "human" being whether as employee, employer or every day citizen. The work of the Ontario Safety League is explained and its object in few words stated to be "the saving of life and limb." It is pointed out that quite aside from the humanitarian point of view the protection of our citizens means adding to our commercial assets. It is shown too that in the long run it is cheaper to protect the workman from accident than to compensate his family for the loss of their bread winner.

As indicating the extent of the work already accomplished by the Ontario Safety League, of which Mr. Wyse is organizer and engineer, the list of affiliated interests shows some 20 or 30 companies, associations, bureaus, etc. The work that has been done in Ontario is already bearing splendid fruit and it is stated that one of our street railways, by letters to automobile owners and teamsters alone, reduced its street traffic accidents in one month by about 40 per cent. The article concludes with some very excellent recommendations regarding the safeguarding of equipment in central stations and in line operation.

In his historical sketch Mr. Wyse also describes the work that has been done on the continent of Europe where museums of safety appliances have been established in many prominent centres, to stimulate the public interest. In this respect North America has apparently very much work yet to accomplish but, considering that the movement is young, and that very excellent results have been obtained with comparatively little advertising, the future looks exceedingly bright.

The introductory remarks of Mr. Wyse were especially significant:—

'Mr. President, Ladies and Gentlemen: I am sure we all feel a deep interest in the subject of reducing accidents, and when we consider that there is a fatal accident in Canada and the United States every sixteen minutes, we realize it is our constant duty to be on the alert for our own, and our brother's safety.

"In 1905, a little girl, about twelve years of age, a companion of my eldest daughter, going home from school, ran behind a street car and was instantly killed by a car coming in the opposite direction. This brought the matter very much home to me, and I then and there made up my mind,

if the chance ever offered to reduce accidents, it would not be a lost opportunity.

"This opportunity offered shortly afterwards, in 1906, when the Ontario Railway and Municipal Board was formed, my firm, then Wyse & Middlemist, was appointed the Board's Engineers, and I was given charge of investigating Provincial Railway accidents and making recommendation for their prevention. Assisted by the most sincere efforts of Mr. Walter McRae, Master Mechanic of the Toronto Railway Company, the Toronto cars were equipped with every device applicable to prevent accidents; this, and the intelligent and careful policy of Mr. James Forest, Claims Agent of the Toronto Railway Company, has resulted in the Toronto trolleys having a minimum of fatal accidents, for any city its size in Canada and the United States, only 13 for last year (1913).

"The reward and satisfaction in the work of accident prevention lies in the knowledge that there are men, women and children to-day, well and happy on your streets, who, had it not been for your efforts in the great movement of "Safety First" would be six feet under the surface."

THE GROUNDING OF DISTRIBUTION CIRCUITS

By S. Bingham Hood

Mr. Hood is a firm believer in the grounding of neutrals at practically all voltages. His paper recounted a number of experiences in the earlier days of grounding neutrals at the lower voltages which all tended to show that lack of success was due to poor grounding. It was pointed out that the greatest care should be taken in this work and that proper connection should be made at frequent intervals with water mains or other metallic underground systems. Mr. Hood is equally convinced of the necessity of grounding 550 volt lines, both from an operative and from a safety standpoint. At 2,300 and 4,000 volts he considers grounding desirable from an operative standpoint and considers also that the life hazard is likely to be less. Concluding, the paper states that in the higher transmission voltages grounding, as in the other systems, is equally desirable. We reproduce Mr. Hood's paper in full.

Discussion

In the discussion which followed Mr. Hood's paper Mr. Dion spoke of the N. E. L. A. regulations regarding the compulsory grounding of circuits up to 150 volts with the option of doing practically as you like above that voltage. Mr. Dion suggested that it would be well for the Convention to go on record as recommending that grounding to water pipes, only, be made compulsory; this on account of the troubles which often arose from poor grounds where other means were used. Mr. Fisk raised the question as to whether a gas pipe would not make a sufficiently satisfactory ground and received the answer from Mr. Hood that where this pipe was 3-ins. or more in diameter a gas pipe should be quite satisfactory. Further contributions to the discussion were made by Mr. Coleman, Mr. Maclachlan and Mr. Mudge. Mr. Mudge moved as follows that a "grounding" committee be formed, and suggested Mr. Hood as Chairman.

The subject of grounding of distributing circuits has been warmly debated for many years but is now in a very different position from what it was two years ago—as the grounding of all circuits up to 150 volts is now insisted on by the National code and by the law of the Province of Ontario. In view of the above I would move that one of the standing committees of this Association for the coming year be a committee on Grounding of Distribution Circuits. Appropriate lines along which this committee might work are as follows:—

1. Obtain information as to Dominion and Provincial laws on the subject, and keep in touch with any legislation either Federal or Provincial which may be made.

2. Obtain information from every electric light and power company in Canada, whether a member of the Association or not, as to their experience in this matter including list of deaths and accidents which have occurred both before and after grounding, their methods of grounding and troubles incidental to same, and how they have been overcome.

3. Obtain information from N. E. L. A. and other authoritative bodies, both American and European, on the subject.

4. Draft recommendations for the advice and instruction of light and power companies as to advisability and best methods of grounding.

5. Make a definite campaign to convince every company in Canada whether a member of this Association or not, that grounding should be carried out, assisting where necessary by advice and information.

6. Assist where necessary in convincing municipal authorities that no harm can come from grounding to water piping systems.

There may be other lines along which this committee might work. By keeping closely in touch with the N. E. L. A. committee on this subject the amount of work of this committee will be minimized as the N. E. L. A. Committee have done much valuable work along this line. The work of such a committee will cost something and an appropriation may have to be asked for to do the work but a few hundred dollars spent in this way will, without doubt save thousands of dollars to Canadian central station companies.

THE VALUE OF ELECTRIC HEATING DEVICES TO THE CENTRAL STATION

By Harold S. Brown

This paper dealt chiefly with domestic electric ranges and their cost of operation though interesting figures were also given regarding the loads developed by electric flat irons, cooking in hotels, restaurants and other public institutions, and various other household and industrial applications. Discussing the electric flat iron it was particularly emphasized that the peak load of the iron does not coincide with the average peak load of central stations. For example, an instance was quoted where there were 4,200 irons in use in a certain city in which the peak domestic power load occurred at 10 a.m. and actually exceeded the lighting load peak of the evening. This indicates how important such a load can be made to a central station which is running very light during the day time.

Mr. Brown's figures on domestic ranges demonstrate very forcibly, by comparison, the advances that have been made in the last few years. Test figures were given showing that the cost of cooking for an average family of 5 is around 3 kw.h. per day, which with a rate of 3c or less is apparently able to compete with gas. Daily cooking records for one week, using the same range, and preparing different menus each time, for five persons, show a total consumption for the 21 meals of a shade over 25 kw.h., or at a cost, on a 3c rate, of 75c. This figures out equivalent to .239 kw.h. per person per meal or, at 3c, a cost of .7c per person per meal. That these menus were thoroughly representative may be seen from Table 1 which we reproduce on p. 49. It is to be noted that this was for a family of five persons. For larger families it may be taken for granted that the cost would be slightly less per individual and for smaller families probably slightly more.

Discussion

A lively discussion followed the reading of this paper. Mr. Leacock asked about the reported saving in shrinkage with electric cooking. Mr. Brown said that popular reports in this respect were, he believed, somewhat exaggerated

but Mr. Moore stated that his experience showed that the shrinkage in electric cooling was about 8 per cent. as compared with from 20 to 22 per cent. with gas or coal; this was largely accounted for by the better construction of the electric oven which made it practically impossible for the moisture to escape.

The question of the value of electric cooking as a load for the average central station, was raised by Mr. McDougall and Mr. Dion. Both agreed that the tendency of electric ranges was to superimpose an extra peak on the already troublesome peak which occurred from five to seven in the evening. Unless it could be shown that the cooking peak would come at an earlier or later hour in the day, it was not evident that this was a desirable load for central stations to cultivate. Mr. Bird expressed the opinion that rather than discourage the use of a piece of household apparatus that promised to become very general and useful, it would be better to adjust the rates. It was not absolutely necessary to make money from the sale of these articles, and the moral influence of encouraging the use of ranges would be such as to encourage also the more general use of other electrical equipment.

An interesting contribution to the discussion was made by Mr. Ratcliffe Hulme who spoke particularly of the number of fires which are caused by electric irons. He believed it would be well to inaugurate a campaign of caution in these matters, as there was no reason why, if ordinary care was taken, there should be any more fires from electric than with ordinary flat irons.

Other speakers included Mr. Wills, Mr. Maclachlan, Mr. Magalhaes and Mr. Ormond Higman. Mr. Wills pointed out that under certain conditions, especially among the working classes, the heaviest meal of the day was prepared at noon, which would prevent super-imposing the cooking peak on the evening lighting peak; under these conditions the cooking load would be a decided advantage. Mr. Maclachlan raised the question of the high cost of ranges and made a plea for a range at such a rate that the average man could afford to purchase it. At the present time it is the cost of the range, rather than the cost of its operation which prevents more extensive developments in electric cooking. Mr. Magalhaes suggested the use of a two-rate meter to encourage the use of the ranges at off peak hours. Under this condition also, the company would be guaranteed a fair rate for the current consumed at or near peak load.

Mr. Higman delivered a short, enthusiastic address on the advantages of electricity in cooking and water heating over any other kind of heat. He stated that from actual experience he was satisfied it was utterly impossible to do as good work with wood, coal, or gas, as with the electric range. Also, where a rate of 2.2c is given, as in his own city, there is no difference in operating costs. In a general way, if the electrical range is economically used, it can be made to compete as to cost, with gas. Mr. Higman also replied to a question asked by Mr. McDougall earlier in the discussion, about water heating by electricity. Mr. Higman was able to cite a case where electric water heating had been installed and cost data kept, which showed that the operation at present is no more expensive and is much more satisfactory than with the Rudd gas heater which had been used previously.

CO-OPERATION IN THE SELLING OF COOKING AND HEATING APPLIANCES

By W. B. Johnson

Mr. Johnson's paper dealt chiefly with the subject of co-operation between central stations and electrical dealers and expressed the opinion that this phase of the industry had not received the consideration it deserved. The good will of electrical dealers means much to the central station. Mr. Johnson stated that it is not so much the price of electrical appliances that is responsible for their sale as the resire on the part of the consumer for that particular article. The campaign should therefore be along the line of educating the people on the practical value of the different kinds of electrical equipment.

It is a very difficult question whether the companies should or should not sell electrical appliances, or whether this industry should be left entirely to the dealers. In any case, however, lighting companies should do all they possibly can to promote the sale of appliances by window demonstrations, personal solicitations, advertising, etc. The co-operation of architects should also be obtained so that they will specify outlets for electrical appliances. Mr. Johnson also believed that companies should quote a fair rate for current for electrical ranges so as to encourage their use, and expressed a hope that it will not be many years until every summer home within reach of a line of a central station will contain an electric range.

In the discussion which followed the reading of Mr. Johnson's paper, remarks were contributed by Mr. Coleman, Mr. Smith, Mr. Scott, Mr. Maclachlan and Mr. Dion. The discussion turned chiefly on the subject of the selling price of lamps of different sizes, the general feeling being towards a uniform price. In one or two instances a view was expressed that these lamps should be the cheapest which produce the most satisfactory revenue.

MAXIMUM DEMAND DETERMINATION AND ITS RELATION TO THE COST OF SUPPLY OF ELECTRICAL ENERGY

By P. T. Davies

Mr. Davies' paper took it for granted that the basis of sale of electrical energy should be on a demand basis and that the use of the demand has little effect on the cost of production. The maximum demand of the individual customer is found to be a most important feature in the cost of supply, on account of the effect of this demand on the diversity factor of the supply system. Mr. Davies quoted a number of illustrating figures to show the small proportion which actual production costs bear of the total cost of supplying electrical power. The remainder of the paper consisted mainly of a discussion of the determination of the demand.

The methods at present in use were discussed briefly, namely:—

1. Demand based on instantaneous peak.
2. Demand based on lowest point of usage during a stated interval.
3. Average load during stated interval.

The first is considered a hardship on the consumer. The second is a hardship to the company, especially as it is possible for the customer, by careful manipulation, to defeat the ends of the contract. The third method is described as the one generally used and the discussion in the paper deals chiefly with the means used to obtain the demand by this method.

The discussion of this question is classed under three headings:—

1. Method of demand period.
2. Number of demands to be taken.
3. Whether a demand, once established, shall remain the billing basis for the balance of the contract unless exceeded.

These questions are taken up more or less mathematically, and worked out according to the theory of probabilities with very interesting results.

SOME NOTES ON STEAM RAILWAY ELECTRIFICATION

By J. A. SHAW

Mr. Shaw's paper described the three systems available as follows:—

1. The three-phase alternating, not suitable for general electrification on account of requiring two trolley wires with the resulting complications.

2. Single-phase alternating current.

3. The 2,400 volt direct-current.

The question is discussed under the headings:—Supply of power, cost of installation, cost of operation, telegraph interference, possible difficulties with 2,400 volts, comparison of systems and conclusion.

The conclusion favors direct-current operations as is shown by his answer to the question, "What is gained by the use of Single-Phase? The answer is that it does not save in cost of installation or operation; its application is not more flexible; it introduces a locomotive that is more complicated; and it reduces cost of sub-station attendance at the expense of locomotive maintenance and consequent reduction in reliability.

INTERRUPTIONS ON LONG DISTANCE TRANSMISSION LINES—THEIR ORIGIN AND MEANS OF PREVENTION

By P. Ackerman

This paper classifies the causes of interruption on long distance transmission lines as, (1) lightning troubles; (2) sleet and wind; (3) birds and other outside interferences; (4) unexpected insulator failures; (5) short circuits on distributing systems. Lightning troubles are stated to be responsible for from 80 to 90 per cent of the total number of interruptions.

Mr. Ackerman's paper discusses particularly the possibilities of improving our insulators and defines a series of tests which had for their object the determination of the ratio of flash-over to puncture voltage, the removal of the danger of burning-off of cables, the effect of the power arc and the gradual weakening with time of the porcelain from which the insulators are constructed. The paper expresses the belief that by a close study of these conditions from 80 to 90 per cent of the line interruptions will be eliminated.

The status of the selective relay protective equipment at the present time is also discussed. The necessary characteristics of the selective overload protection system is stated to be (1) A definite time characteristic for the relay on heavy short circuits—that is a certain definite time to trip the switch no matter how heavy the short circuit current may be; (2) Accuracy; (3) Reliability. The opinion is expressed that with the more recent apparatus these necessary characteristics are being obtained.

The paper concludes with the following optimistic remark: "Hope can be entertained that the insulator problem will be solved, at least to such a point that the chief causes of present transmission line troubles will be eliminated and that with some further development in relays such selective action may be obtained that total interruption will be safely guarded against."

Mr. Ackerman's paper was discussed by Mr. Maclachlan, Mr. Hood and others.

HIGH EFFICIENCY, INCANDESCENT LAMPS AND THEIR APPLICATION

By H. J. Madgfick

This paper dealt with the wonderful improvements that have taken place in the making of lamps during the very recent past, pointing out the development in efficiency over the old carbon lamp which consumed about 3 watts power candle, as compared with the present nitrogen-filled lamp which consumes, under the most ideal conditions, ½ watt or less per candle-power. It was pointed out that in addition to the very economical consumption of these new lamps, the distributing characteristics are such as to add still further to their economy in operation. The different types of lamp at present on the market and their satisfactory results were described. Series street lamps of the lower wattages (down to about 80 watts) and multiple lamps of 750, 1,000, and upwards, watts consumption give entire satisfaction, both as to cost, operation and maintenance. In answer to a question, the speaker stated that the latest type of nitrogen lamp would burn equally well in any position.

SOCIETY FOR ELECTRICAL DEVELOPMENT

Mr. Wakeman, the president of the Society for Electrical Development was present, and addressed the delegates on Thursday morning. Mr. Wakeman outlined briefly the work of his society and explained a number of interesting details in connection with the progress already made. The watchword of this society is "Co-operation." That man will be the greatest business success who best knows how to cooperate. The object of this society was to bring together central station, dealer and contractor so that these may work in unison for their mutual benefit in the development of the electrical business market. At the present time 1,382 companies have been included in the movement and the sum which they set out some time ago to raise, namely, $200,000, has now been pledged. Mr. Wakeman instanced a number of cases where they had been of assistance to isolated central stations. Central stations are instructed in the best method of getting business and under certain conditions are even supplied with skilled solicitors for a given time. Mr. Wakeman stated he had been told by one of the member companies that morning, that the solicitor sent to them had resulted in sufficient business being added to pay their subscription to the society for the next ten years. Answering a question of Mr. Scott, the speaker stated that an effort was being made to include electrical inspectors in the society so that these may work in unison with the other members.

DOMINION TESTING LABORATORIES

Mr. Ormond Higman, head of the Department of Electrical Inspection for the Dominion Government, spoke of the work of his department during the past year. He stated that the branches at present under construction in Vancouver and Winnipeg are making excellent progress and that the Vancouver branch is very nearly completed. These will compare favorably with other electrical testing laboratories on the continent and will include up-to-date machinery. Each branch will also have on its staff a skilled instrument maker.

Answering a question by Mr. Dion regarding the status of The Maximum Demand Meter, Mr. Higman stated that as yet only one had been presented for verification. Though the question had not been definitely raised, it was not likely that the Government would pass any meter with a maximum rating of less than a ten-minute period. This seemed a somewhat arbitrary decision to Mr. McDougall who pointed out that under certain conditions it was often deemed advantageous to sell current on shorter peaks than ten minutes. Mr. Higman replied that his reference had been to the smaller consumer which it was the special desire of the Government to protect.

Mr. Maclachlan rose to express the appreciation of the Association that Mr. Higman should have shown so great interest in the Association's work as to come to Montreal and give them this interesting address. A vote of thanks was enthusiastically carried.

Some Notes on Steam Railway Electrification

By J. A. Shaw, Canadian Pacific Railway Company*

The determination of the preferable system for electrifying a section or branch of a railway, involves that best adapted for general service. If successful, their installation may be extended as electrification of other portions of the road may prove desirable. This will depend on the success obtained in economical and reliable operation. It is necessary in view of further extensions to select a system suitable for general conditions to obtain interchangeability in rolling stock. Possibly different systems may be used on different parts of a road, but each will have to operate under all conditions on the district on which it is installed.

Systems Available

Three systems now exist which include all which need be considered in view of the present state of electrical development. One, the three-phase alternating, is not suitable for general electrification, on account of requiring two trolley wires, with the resulting complications and the peculiar characteristics of the motors employed. The remaining two systems are single-phase alternating current, and the 2,400-volt direct current.

The single-phase system has been used in the electrification of the New York, New Haven and Hartford Railway from New York to Stamford, and is now being considerably extended. It has also been used on a number of light railways, notably the Spokane and Inland. Abroad it is in use on the London, Brighton & South Coast Railway, the Swedish State Railway and others, and has been adopted by the German, Swiss and Austrian State Railways as their approved system, although it cannot as yet be considered as completely through the experimental stage.

The 2,400-volt direct current system is a development from the 600-volt system, which is practically the standard in all street railway and interurban work, and which has been so successful on that field. The electrification of the New York Terminals of the New York Central and the Pennsylvania Railroads, the Atlantic City Line of the Pennsylvania, the New York Subway, and all elevated railways have also employed this system. Abroad it has been used on the Lancashire and Yorkshire Railway and in general under conditions similar to those in this country. During the past three years a number of light railways have been installed using 1,200-volt direct current, in most cases, however, using 600-volt motors, and from the experience obtained, the 2,400-volt system has been developed, using 1,200-volt motors, and this system has now been in use on the Butte, Anaconda and Pacific Railway, preparatory to a further use of it on two divisions of the Chicago, Milwaukee and Puget Sound Railway, for the past 10 months. A lower voltage installation at 1,500 volts has been in service over three years on the Piedmont Railway in South Carolina.

Supply of Power

It is possible that in the majority of cases for years to come that power will be generated for locomotive purposes alone, without considering its use for other purposes. However, electrification will be made possible more through cheap power being available from existing power plants, where if a seperate plant had to be erected it would be too expensive. Possibly in the future power plants will be constructed at points where commercial power is not available, but even in that case at other points on adjoining divisions commercial power might be obtained, and to permit of uniform equipment the power generated would either have to be uniform with that purchased or the latter converted to the character required. Throughout the West and in the Montreal district, 60-cycle, three-phase transmission is practically universal, and while 25-cycle, three-phase current is employed on the Hydro-Electric and Toronto-Niagara transmissions from which 25-cycle single-phase could be obtained by stationary transformers, balancing apparatus would be required. In view of the tendency to use 15-cycle in place of 25-cycle current in single-phase electrification and the remoteness of general electrification in Ontario, it is reasonably safe to assume that converting apparatus will be required for either single-phase or direct-current installation. The application of 15-cycle generators in 60-cycle power stations or of frequency changing apparatus to furnish single-phase current, while possible, does not actually change this assumption, as the increased price asked for by the power companies equals the cost of conversion by the railroad in addition to requiring the erection of separate transmission lines.

General Arrangement

The general arrangement of the two systems may be outlined as follows:—

Single Phase	Direct Current
A 1. Power line of supply company.	D 1. Power line of supply company.
A 2. Conversion station at one or two points per division furnishing single-phase current from motor-generator apparatus and step-up transformer for raising potential. If power lines are available at several points on division, number of conversion stations may be increased, and length of transmission lines correspondingly reduced.	D 2. Transmission line to sub-stations. Where supply company power lines are available at several points on division, sub-stations may be conveniently located at such points, and length of transmission line correspondingly reduced.
A 3. Transformer line from conversion stations to transformer stations.	D 3. Sub-stations in which three-phase power is converted to direct current by motor generator apparatus.
A 4. Transformer station in which high voltage single-phase current is transformed to 11,000 volts for trolley line.	D 4. Feeder line to which direct current is supplied to trolley line.
A 5. Trolley line and bonding.	D 5. Trolley line and bonding.
A 6. Electric locomotives or motor cars.	D 6. Electric locomotives or motor cars.

Cost of Installation

An inspection of above table shows that as a general proposition certain of the items are practically common to both systems. Transmission lines A-3 and D 2 will be required for the entire length of the division if power were received at one point; whereas if power were received at several points, while several single-phase conversion stations could be installed, that would not prove practically econom-

*Read before Montreal C.E.A. Convention.

ical, and with direct current there would be a saving in the transmission line required. The transmission line for single-phase current costs 20 per cent. more per mile than that for three-phase, so that it is entirely fair to the single-phase to consider the cost of transmission lines equal.

The trolley line and bonding are practically the same. For single-phase, higher insulation is required on account of the higher voltage and the surging which occurs. With the improvements that have been made in the manufacture of insulators, the difference would not exceed 10 per cent. of the cost of the trolley line.

The conversion stations and transformer stations A-2 and A-4 for single-phase, will correspond to the sub-stations D-3 for direct current. For heavy traction work on the Chicago, Milwaukee & St. Paul Railway, where it is proposed to handle 1,600 tons on 1 per cent. grades, the sub-stations will be located from 18 to 24 miles apart, the feeder being 1,000,000 cm. Considering a direct current section having sub-stations 20 miles apart, the distance between transformer stations for single-phase current will depend on the worst conditions that should be permitted to occur. Thus with the direct current with a voltage drop of 50 per cent., trains could be handled at one-half speed with full tractive power. With single-phase the maximum drop permitting this condition would be from 20 to 30 per cent. The latter figure will be taken as most favorable to single phase, and the distance apart of stations calculated: 1st, when the number of trains on a section is proportional to its length; 2nd, when the same number of trains are concentrated at the centre of a section irrespective of its length. The spacing of the stations can also be calculated when the efficiency is the same for both systems, the number of trains per mile of track being the same. The results are as follows:—

Limiting operating conditions, trains uniformly distributed or number proportioned to length of section ... ... 30 miles
Limiting operating conditions, same number of trains at centre of section ... ... 45 miles
Equal efficiency, number of trains proportioned to length of section ... ... 30 miles

The limiting operating condition with the number of trains proportioned to the length of the section is evidently most important from a general railroad standpoint, and transformer stations, say 33 1-3 miles apart, would apparently give substantially equal service compared with direct current sub-stations 20 miles apart. The total capacity of the direct-current sub-station will exceed that required in the conversion station, since each sub-station must be able to carry the load of the trains that may be starting in its vicinity. The total cost of the single-phase stations is, however, increased by that of the transformer stations, which cost one-third as much per kilowatt capacity as the conversion or sub-stations. The two systems are thus equal in cost when the sub-station capacity with direct current is 44 per cent. greater than the conversion station for single phase. In some cases the difference is not sufficient, but lines will not be electrified on which traffic is insufficient to render the load reasonably uniform. As in the case of the transmission line and trolley the single-phase was more expensive; in this case the direct current will be in general slightly higher—the net results being very closely the same.

The remaining items are: A-6 the single-phase locomotives, D-4 the direct-current feeder, and D-6 the direct current locomotives. The feeder proposed is of 788,000 cm. area, costing at 18 cents per pound, \$2,250 per mile or \$2,500 per mile erected. The cost of the locomotives will vary according to the type and capacity, but based on direct current locomotives costing \$40,000, those for single-phase current will cost \$60,000, so that if one locomotive is used for each eight miles of track, the total cost of the two items is again substantially equal.

The net result is that where power is obtained from three-phase distribution, the cost of electrification by single-phase or direct-current is substantially the same. This is confirmed by several careful independent estimates. With direct current the expenditure on feeder copper and sub-station apparatus is balanced by the slightly increased cost of the trolley and transmission line for single-phase current and the much greater cost of the locomotives.

Cost of Operation

Cost of operation is affected by the efficiency of the system, the cost of operation of the sub-stations and the cost of the maintenance of the locomotives and other apparatus.

The efficiency of the system will determine the cost of the power supplied, and, if the movement of the trains and the power they each consume is known, could be calculated with considerable accuracy. When power is purchased, especially water power, the cost depends on the peak load during certain hours, and trains will be operated to reduce this as much as possible. It is therefore difficult to forecast the train distribution. There is, however, no general evidence to how that greater efficiency may be obtained with single-phase than with direct-current equipment. Several records of actual service show that with direct-current under similar conditions the results are more economical than single-phase. This is especially so when the power per car mile is considered on account of the greater weight of the single-phase equipment. From what we have already learned and figures published, it may be safely assumed that on any section of a railway on which there is sufficient traffic to justify electrification, the power required by direct current will not exceed that required for single phase.

The cost of sub-station maintenance and operation is greater for direct current. On a 100-mile division there would probably be five (5) sub-stations, each containing moving apparatus which requires attention as against one for single-phase system. Each of these sub-stations would cost from \$3,000 to \$4,000 per year, or say \$18,000 per annum, against \$4,000 for the single-phase station. It is doubtful whether the wages cost of \$2,000 per year per station, or \$10,000, is a proper charge against the direct current. On main line work it will be absolutely necessary to arrange to cut out any portion of the road on which accidents may occur, and for this purpose attendance will be required. Trains must be moved away from any section temporarily disabled to prevent congestion, and of the \$14,000 additional cost it would appear entirely fair to estimate that about \$8,000 is the most that would be entailed by the sub-stations. This is more than equalized by the greater cost of maintenance of the single-phase locomotive. Direct-current locomotives are being maintained for 3¼ cents per mile, of which 2 cents is entirely separate from the electric motor, control, etc. On the single-phase locomotives, the cost has been higher, but it is hoped to reduce it to between 5 and 6 cents. For short distances the direct-current locomotives as used out of New York will handle a train that requires two single-phase, and if this were allowed for, the difference would be very great. The new switching and freight locomotives on the New Haven, it is stated, have been maintained for a comparatively low figure, but they have as yet not been in service sufficiently long to give a final value. The construction of all single-phase locomotives is far less sturdy than that of direct current, on account of the difficulty of keeping the weight down to a reasonable amount, and the construction is far more complicated. It cannot be expected, therefore, that they can be maintained for a lower percentage of their total cost. A fair difference to assume

is that cost cannot be taken at less than 2 cents per mile for locomotives of equal power, say 1,000 h.p. each. Considering a division with 1,000,000 miles per year, or $20,000 at this figure, so that the cost of operation and maintenance of sub-stations is more than taken care of by the increased cost of maintenance of equipment. The single-phase locomotive is also considerably heavier than the direct-current for equal power, and this is especially true when motor car equipment is considered. This increase in weight means a correspondingly reduced train load, unimportant on level districts, but of appreciable amount on heavy grades. It also entails an additional expense for power which is serious in light passenger or motor car service. There is, of course, a possibility that 2,400-volt direct-current apparatus will cost more to maintain than 600 or 1,200-volt, but there does not appear to be any reason to fear its becoming excessive. While there is no doubt that the New Haven have had more electrical trouble than the New York Central and the cost of repairs has been higher, due to the mechanical construction of the locomotives rather than to the electrical equipment. This mechanical construction is, however, necessitated by the use of the single-phase motor. While there is no reason why the same construction should not be employed with the 2,400-volt direct-current system as with the 600-volt. In general, there is no reason to expect the cost of operation with the single-phase system to be less than that with the direct current.

Telegraph Interference

One of the objections to the use of single-phase current is its effect on telegraph and telephone wires. It is stated that this may be overcome by the use of suitable apparatus or by moving the wires to about 200 feet from the power lines. It is questionable whether either of these modifications will entirely eliminate the difficulty, and it is certainly an objectionable feature. With direct-current the corresponding difficulty arises from electrolysis, but this is far less important in railway than in street railway work, in which it has been largely overcome.

Possible Difficulties With 2,400 Volts

The above discussion considers that 2,400-volt direct-current will prove equally satisfactory as 600 or 1,200-volt installations. In a system that has not been thoroughly demonstrated in practical service, there are some features from which trouble may be experienced, and these are discussed as follows:—

The simple and strong design of the direct-current locomotive is partly due to the use of geared locomotives for freight service and gearless for passenger service. The construction which has been adopted and which is practically necessary for single-phase locomotives of any size, supports the motor entirely independent of the wheels, the latter being driven through springs or connecting rods, thus reducing the dead weight to that of the wheels and axles alone, while retaining the same total weight on each wheel. The centre of gravity of the locomotive is also raised to a point approximating that general for steam locomotives. From experiments conducted on engine and tender trucks and the experience of maintaining track under various types of locomotives, it is safe to assume that the dead weight of 9,000 to 10,000 pounds per axle on gearless locomotives and the slightly greater weight on geared, does not, for the services in which they will be respectively used, appear likely to affect the cost of track maintenance sufficiently to justify the additional expense and complication involved in reducing it. In view of the greater total weight of the single-phase locomotive it is very doubtful whether its effect on the track will not be greater than the direct-current locomotives, even though the dead weight per axle is higher in the latter. Increasing the height of the centre of gravity reduces the lateral shocks on the rail, but this action is caused by these shocks in steam locomotive design being absorbed by the vertical movement of the springs. It will be unfortunate if electric locomotive design cannot be developed in which these shocks are absorbed by springs, or frictional methods of restraint, so that the simplicity which should accompany the application of motors to drive the wheels of a locomotive may be retained; there is no reason to doubt this being accomplished. Should it prove impossible, the direct-current locomotives would become more complicated and approach the single-phase more closely in cost, the difference being probably 25 per cent. in place of 50 per cent.

The question of current collection at 2,400 volts at high speed has been experimented with, but not fully demonstrated as yet in service. It has been found practical to collect 200 amperes at 60 miles per hour from one roller trolley without injurious sparking, which at 2,400 volts equals 480 kw. Two trolleys can be located 20 feet apart, thus permitting 960 kw. on one locomotive. This question is important, but there seems little question of its being solved satisfactorily. The control of 2,400 volt current does not appear to present any difficulty. Contactors will be arranged to break the current in series, and from results in operation there seems no reason to anticipate any more trouble with 2,400 volts than with 600. Maintenance of motors may be higher with 2,400 volts than with 600 volts. The motors will, however, operate under 1,200 volts each, and the fields in both motors will practically be at ground potential. Twelve hundred volt motors have operated interurban work for five years without indicating any increased cost of maintenance, and while this has been in a dry climate, the forced ventilation to be employed in railway work will give very closely the same condition. The 2,400-volt motor will have the same capacity to stand heavy starting load, the same freedom from commutation trouble, and in general the same ability to stand the severe service imposed upon it by locomotive or traction work that the 600-volt motor has been proved to possess.

The operation of fan and compressor motors on high voltage has to be properly worked out. There are no doubt some difficulties in this respect, but they should certainly be overcome by experience.

Comparison of Systems

It has been shown that on the assumption that the 2,400 direct-current and the 11,000-volt single-phase current system each operate as satisfactorily as their advocates claim, that there is comparatively little difference in their cost of installation and operation. Each is equally flexible, each will operate and in all probability give a high degree of satisfaction compared to steam locomotives. The principal difference is that, with the direct current a larger portion of the cost of installation is in feeder copper and conversion apparatus, and less in the locomotives, and a larger portion of the cost of operation is in the sub-stations, attendance and maintenance in place of locomotive maintenance. This of itself should prove decidedly to the advantage of the direct-current system, as the sub-station apparatus is stationary and can be carefully maintained, and the simpler and cheaper the locomotive the less danger there will be of a breakdown. In addition, the investment in copper is permanent, while that in locomotives may rapidly depreciate with any new developments. There are, in addition, some minor points worth attention which may be referred to.

The regulation of speed on the single-phase system is in many ways preferable to that on the direct current. By drawing current from the transformer at the voltage suitable to the speed and power required, all speeds are equally efficient, and the use of resistance in the circuit is avoided.

This is an exceedingly ingenious method, but it is doubtful whether it is of great practical importance. While the direct-current motors have only two full-power efficient speeds, decreased power can be obtained at higher speeds than either of them by field control with very small loss in efficiency. This would apply particularly in passenger service, since in freight service the characteristics of the motor are such that it would not be required. The use of a transformer on the single-phase locomotive permits the operation of the motors at low voltages, and on ungrounded circuits. There seems, however, no reason to fear the use of high voltage on the direct-current motors, or danger, providing it is properly insulated. There has certainly been more trouble on the single-phase from grounds than on the direct-current, and it appears to be entirely a question of proper insulation. The relation between the speed of the motor and the power it will develop is different for single-phase and direct-current. Taking two motors which will develop the same power at a given speed, the direct-current will develop greater power at lower speeds and less power at higher speeds than the single-phase motor. This is the reason for the success of the direct-current motor in traction service. It can exert a greater pull without injury and is less liable to damage from overheating when starting a heavy load than any other type of motor. It is also this feature which makes the gearless locomotive a possibility for passenger service, as it enables a motor of reasonable size to start a passenger train without the use of gearing to furnish the necessary power. Direct-current motors can certainly be constructed to handle passenger trains at high speed if desired, so that in this respect the advantage is greatly in its favor. The direct-current motor has obtained its reputation for ruggedness from its capacity to withstand heavy loading without injury.

Conclusion

If in place of discussion the relative advantage of single-phase and direct-current traction, the start is made from the direct-current system with its simple and strong electrical apparatus developed after years of experience by simply an increase of voltage, and assuming that this increase does not lead to unforeseen difficulties, the question becomes, What is gained by the use of single-phase current?

It does not save in cost of installation or operation.

Its application is not more flexible.

It introduces a locomotive that is more complicated, in which the motor is necessarily far more expensive and elaborately constructed, and which weighs considerably more than one for direct-current.

It reduces cost of sub-station attendance at the expense of locomotive maintenance, and consequent reduction in reliability.

The general advantages to be gained by electrification are too well known to bear repetition, but it might be mentioned from the data now becoming available from those installations now in operation that results obtained confirm estimates very closely. The engineers of the Chicago, Milwaukee & St. Paul Railway, estimate that at least a saving of 25 per cent. will be made in operating costs on the 440 mile division now to be electrified in the Western States, and part of this saving is confirmed by the showing already on the Butte, Anaconda & Pacific Railway, where power cost has been found to be but one-third of the previous coal cost. The decision to electrify the suburban lines of the Pennsylvania Railway about Philadelphia, was made to relieve the existing congestion by increasing the capacity of terminal 15 to 20 per cent., or sufficient to relieve the situation for the next five or six years and at less expense than any other method.

Grounding of Distribution Circuits

By S. Bingham Hood, Toronto Electric Light Co.*

To ground or not to ground has been a question occupying the minds of central station engineers, and the columns of the technical press, for many years.

This question has progressed from the point where it was thought to be criminally negligent to allow a ground on a circuit to that of being thought equally guilty not to allow a ground.

If we go back a few years we find the National Code forbidding the operation of any circuit with a ground on it, then allowing it by special permission; next suggesting that it be grounded; and, finally, in the last edition, making grounding compulsory up to 150 volts, and optional above this pressure.

Almost the entire argument upon which grounding is based is that of reducing the life hazard. What more sound basis for argument could we wish for? However, this is the smallest part of the argument, considered purely from the central station standpoint. True, none of us wish to see our customers transferred to Kingdom Come, or the other place, but we do wish to increase the reliability of our system.

In a system of any size, particularly where the much desired interconnected network of low-tension supply is used, it becomes almost a physical impossibility to keep grounds off the system for any length of time. Many of us here can remember the old days of the ungrounded network (and, I regret to say, some of us are still in the old days), where John Smith's basement light is hard up against a water pipe and he, unknowingly, tests all his neighbor's wiring insulation at double its normal voltage. About this time Mrs. Jones sets her electric iron down on her gas stove (the iron, as usual, being broken down in its interior anatomy) while she interviews the ice man.

Mrs. J. postpones her ironing and Smith falls down his cellar stairs in the dark. Now what happens? Mrs. J. picks up her iron, looks it all over, outwardly, and sets it down where it belongs—on its stand on the ironing board; then sends for the electrician, who calls, looks wise, and says, "Your plug is too small," and puts a 20 amp. on a branch circuit which is only good for six amperes, but will safely carry 15 any old day, and may, as a special favor, now be fused and approved for 10. Bill, 75 cents.

Smith does not believe in electricians, and can't find a new fuse plug, so uses the old one backed up with one of our much-despised Canadian coppers. In addition to curing his trouble, he has established a "permanent and effective" ground on our system and don't care a hang whether it is approved or not.

Probably the next ground is outside somewhere where it has no fuse to blow, and friend Smith loses his cent together with some other of his household effects.

Now, when the Code finally allowed grounding, many of us saw daylight ahead and thought we had the answer to the whole problem by simply putting a collar on our stray cat

*Read before the Montreal C.E.A. Convention.

and chaining him fast at the middle point of our potential distribution. We hunted up some old gas pipe, drove it a few feet into the ground, hooked it up to our neutral and stood back to await the results.

What was the result? Somebody comes along on a nice damp day and leans up against our salvation and immediately dreams a few new dance steps. We send out a trouble man who finds the ground pipe charged, and to find out how heavily, jumps it onto a fire hydrant or car track. Bang! and it is all over and the trap is set for the next victim. This happens a few times and the ground pole gets a bad name. Result, our trouble man cuts off the ground wire and we are back where we started and the old cat jumps over the fence again.

I went through this experience about ten or twelve years ago, and I suppose nearly all of you have had a very similar one or are now in the midst of this continuous performance.

Now, gentlemen, I am going to tell you what I kept a state secret for some years, to save my own neck. If my old chief were here he would now understand why I got such good results from these grounds in my district, and why other districts were meeting with worse than failure. I carefully picked the points for my ground connections and, having all my neutrals tied together, had about a dozen favorite points which I knew would work. I will not attempt to describe all of them, but can recall two which were particularly effective. In one, our pole line rested right on the edge of a twelve-inch water main. One pole bore so hard on the side of this that I protected it by a good-sized cast lead plate formed to fit the curvature of the pipe. By accident (?) one end of our ground wire got cast into this plate.

In the other case the owner of a large building closed his contract before he built the building, and to avoid having the service conduit show on the front wall had us build it into the wall as it went up. The 2/0 neutral, again by accident, passed through the wall of the conduit about in the centre of the brick wall and branched off between the courses and finally wound up, literally, around the main water service just before it entered the basement.

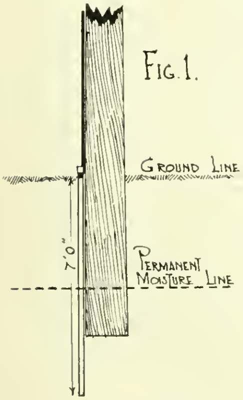
The results gained in this way have firmly convinced me that the only permanent and effective ground is direct to a water or other piping system laid in the ground, and to attempt to get reliable protection in any other way is a sheer waste of good time and money.

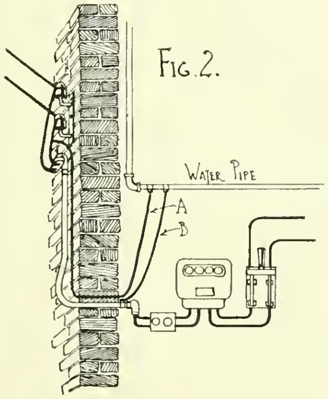
At first sight it may not appear clear why these driven grounds give such average poor service. Upon closer investigation, however, it becomes very clear as to why they fail. I have made numerous resistance tests on this class of ground, and have found the resistance to vary from five or six ohms, where a ¾-in. pipe is driven seven feet into wet ground, to as high as 180 ohms on a similar pipe in same ground after a long spell of dry weather. Such a ground can only be figured as to effectiveness under its worst condition. A fair average resistance would be 60 ohms. Considering buried plates, ground cones and similar devices, the average resistance will be about one-half of this owing to their being buried with their active surfaces planted deeper and generally in permanently moist earth. For the same reason their maximum and minimum resistances will not vary nearly as much as in the case of a driven pipe. The chief defect of these latter class of grounding devices is their inability to withstand corrosive action of most soils for a long period of years. This, together with their higher first cost, makes them almost prohibitive for use for the purpose for which they are designed.

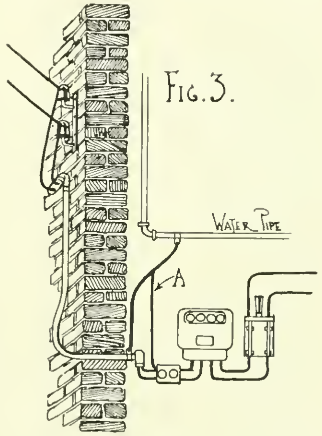
Referring to Fig. 1, we have a typical driven pipe ground in which we have seven feet of pipe in contact with earth in wet weather, and about one-half this is extreme dry weather. Under these conditions our ground is only one-half its maximum effectiveness under the latter conditions of moisture. If the soil is composed of sand and gravel we lose practically all our protection in dry weather and reclaim but little in wet weather, as path of lowest resistance is then in top soil only.

Now, assuming a small net work protected by one driven pipe with a resistance of 60 ohms, we get an accidental ground on one side of our three-wire system, or on the other wire from that to which ground is connected on a two-wire system. Immediately our ground wire and pipe is raised to 110 volts above earth potential. The potential then decreases to zero through the earth contact with the pipe. From tests made it has been found that this zero potential condition is not established until we get at least a foot away from our pipe. In other words, we have a cylinder of earth with the pipe for its axis. The outer walls of the cylinder are at zero potential and the axis 110 volts above, or below. This explains why a person standing close to a pole where ground exists will receive a shock and not be actually touching either the pole or the ground wire. In high-tension transmission systems using iron poles, or even wooden poles in wet weather, one can get a severe shock by walking within several feet of the base of pole or tower.

One of the first requirements of a successful ground connection is that it must pass sufficient current at 110 volts to at least blow a branch fuse of 10 amperes. One of these pipes will not blow, under average conditions, more than a two







ampere fuse; therefore we must provide at least five driven pipes on each section of our secondary network.

The second requirement is to blow the largest fuse in our primary network in the event of a cross occurring between primary and secondary systems. This fuse would probably be, in a fair size system, 150 amperes. One driven ground would pass about 40 amperes, and we must have at least four ground connections to insure proper protection. If the cross occurs in the transformer or on a small fused branch primary line, then one driven ground will protect. This is, however, an exceptional condition, and to obtain absolute protection our grounding system must be of sufficiently low resistance to pass the heaviest current possible to obtain, and also to open up the protective device controlling this heavy current. Applying this rule we will find that, to prevent our ground leads becoming charged with low potential current, due to an accidental ground on the other side of secondary network, we must provide a very low resistance path. For instance, if the heaviest main fuse of any customer is, say, 150 amperes, we will need about 80 driven ground pipes to make our system self clearing. It is clearly impracticable to get such results by this means of grounding, as it would require a ground on every pole along a stretch of line nearly two miles in length, even if we neglect the resistance of such a long length of neutral conductor.

Aside from the impracticability of such driven grounds there is another factor of danger, to both our employees and the public, which enters into their use when installed at the pole base, as generally located. If, in the event of a high-tension cross, the primary protective device fails to open the ground wire and pipe becomes charged to 2,300 volts potential and any one touching it would probably receive a fatal shock. If the condition is maintained for any appreciable time the leakage from ground pipe at ground line to the moist ground line area of the pole will result in setting the pole on fire, and not only damage our construction but attract attention to the unusual condition and very possibly induce someone to touch the pole, or ground wire, who would otherwise not be called upon to go near it.

The second and ever present danger in this method of grounding, and one which exists independent of the ground resistance, is that of having any uninsulated grounded conductor on any wood pole line upon which high-tension lines are strung. This danger is one which affects our employees to the greatest extent, as they are practically forced to handle high-tension lines on what is to all intents and purposes a metal pole. To ask any lineman to do this is little short of criminal, and numerous fatal accidents have resulted from this practice.

Now compare these crude and prohibitively expensive, as well as ineffectual methods of grounding, to that of grounding directly to a water main on the consumer's premises.

Assume we have a No. 8 service line and that the ground is made by tapping the neutral service line at the building bracket and carrying it down the outer wall and into the basement, where it is clamped to the water pipe. We have a total resistance of at most one-fourth ohm and can pass an instantaneous current of over 400 amperes at our lowest operating potential. Here the capacity for protection is governed entirely by the safe carrying capacity of the ground and service wire. Number 8 wire will carry 60 amperes for a considerable time without dangerous heating, and we can get absolute protection under the most severe conditions from four of such grounds.

Using Service Conduit

The steadily growing standard practice of bringing service into the basement through a service conduit or standpipe simplifies grounding very materially. Figure 2 shows such a service with ground wire carried down the outside and connected to water pipe as suggested in the Code. This, I think, shows clearly the unnecessary and unreasonable economic waste of this proposed method. The ground wire (A) is clamped to the water pipe. Immediately adjacent to it is another clamp connected to the grounding wire required for the service conduit. The neutral wire inside the standpipe is of same potential as ground wire outside, and can just as well be made to serve as the grounding lead as well as the neutral. This service conduit neutral in small installations will probably not be larger than number 12, so more grounds will be required to give safe carrying capacity on a large system. The proper and most economical method of grounding, and one which I have used with uniform success for a number of years, is that shown in Fig. 3. Here we have the service conduit grounded (by the wireman who installs the job) to the water pipe. The neutral ground (A) consists of a short piece of wire, of same size as service conduit wire, tapped from neutral line lug on service block to a convenient point on the conduit ground wire. This gives a permanent and effective ground at a cost of about 10 cents as compared to probably $1.50 if run down the outside of building, and probably $3.50 to $5.00 if driven pipe is used at pole. At this low cost every service can be properly grounded, as now called for in the Code and Provincial Rules, at an expense so small as to be negligible, leaving absolutely no excuse for further postponement of giving our customers, and the public at large, the protection against injury or death which they have a right to demand.

With such a system of grounding the entire expense would be covered many times over by the damages we would have to pay from one fatal accident. The central station which postpones grounding one day longer than necessary after such simple means of carrying it out are shown to exist, may expect, and heartily deserves, the severest censure and heaviest damage any court can grant.

In those cases where service enters by the old method of porcelain tubes through an upper wall of the building, suitable grounding becomes somewhat more complicated. The usual method is to run a fairly heavy wire, No. 8 or larger, down the outside wall and through into basement to water pipe. It frequently happens, however, that suitable grounding points may be found much closer to the service. For instance, the ground wire may be carried down to opposite a bath-room, where a small unbushed hole may be drilled through wall and ground wire clamped to a section of exposed piping under some of the fixtures of the bath-room. Again, the vent pipe may pass through the roof near the point of service attachment, in which case the ground wire is clamped to vent pipe by a large copper clamp band. Another method would be where a building is piped for hot water heating, in which case the overflow from expansion tank generally passes through the upper wall or roof. The ground wire can be clamped directly to this overflow pipe.

Some of these methods might not be desirable if only one ground were depended upon; but if we ground every service, we can rest assured that a very large proportion of the ground connections could be more or less defective without materially decreasing the protection to our system or the public safety.

In order to convince our various inspection departments of the absolute safety and reliability of such grounding methods, I would mention that on the system with which I am connected there are over twenty-five thousand customers so protected, and there has never been one indication where any damage or injury has occurred to either persons or property which could be even remotely traced to the grounding method used.

During a period of three years under this method of operating, the total expense for repairs to transformers, meters, service equipment and customers' installations, caused by insulation breakdowns due to both lightning and high-tension crosses, has been less than two thousand dollars.

The period immediately preceding this was one filled with trouble. Meter and transformer burnouts were frequent and serious. Every storm meant three or four transformers to replace and meters by the dozen.

The effect upon the customers' wiring was even worse. Our large secondary networks acted to distribute a high-tension cross over a large area and resulted in simultaneous breakdowns at numerous points. I recall one cross which damaged customers' wiring and apparatus in over fifty places. In this case repairs to fixtures, fittings, and decorations re-

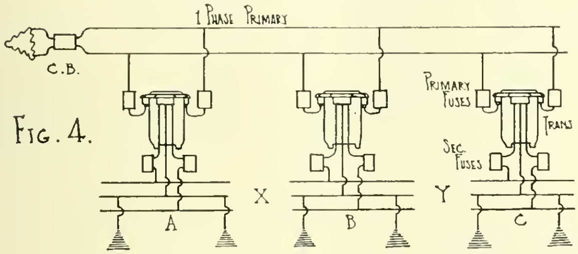


Fig. 4.

quired several weeks' time of a large number of men and involved an expense to the company of over $800.

Another case covering a widespread area cost over $3,000 to repair; and smaller mixups costing anywhere from one to three hundred dollars were common.

By good luck or an act of Providence we were fortunate enough to have this damage confined to property only, none of our customers, as far as I know, having been injured in any of these catastrophes.

Surely this is evidense enough of the desirability of grounding from an economical standpoint, neglecting the humanitarian aspects of the problem.

We have further utilized this grounding to not only eliminate practically all the usual operating troubles of a large system, but to reduce our distribution investment by over $50,000—and we are not done yet.

In order to thoroughly understand the development of the system and to show the various steps leading up to present distribution standard, we must consider each of these steps in their proper order.

Referring to Fig. 4, we have a delta connected primary system from each phase of which single phase primary distributors are taken off through oil circuit breakers. The various secondary networks, indicated as A, B and C, are shown served by a single unit, but in practice were generally each supplied by from two to six or eight units, each of these small secondary networks covering a block of considerable area. At this time it should be noted that the neutral ground connections consisted of driven pipes, three or four to a section.

From time to time additional load was obtained adjacent to the gaps between sections, as at X and Y. Investigation showed that these loads could not be properly supplied from either existing section except by running additional copper or erecting more transformer units. It was, however, found possible to carry such loads, in many cases without additional investment, by connecting these sections together and utilizing the diversity factor which was found to exist at such points. With the development of the networks these gaps were closed in one by one until an inter-connected area of from 150 to 200 kw. in transformer capacity was obtained, this condition being shown in Fig. 5.

With the old Fig. 4 arrangement the grounds were not giving good results, as they were not of sufficiently low resistence to blow customer's fuses in case of a ground on an outer on customer's wiring as previously explained. With the interconnection of the smaller networks, giving the Fig 5 arrangement, this trouble largely disappeared. In the event of a heavy ground or cross, however, conditions were worse than before, owing to the wider area covered by the trouble.

In order to overcome this the practice of grounding directly to water pipes, by method shown in Fig. 3, was adopted, placing one such ground connection every 300 or 400 feet on the secondary main. This immediately stopped all further trouble on the customers' wiring and largely eliminated meter and transformer burnouts due to lightning or superimposed high-tension currents. No additional primary troubles developed, and there seemed to be a slight decrease in those already known and of former frequent occurrence.

About this time it became necessary to carry, at short notice, a large temporary lighting and power load far beyond the capacity of existing feeders, and on too short notice to permit of installation of additional feeders. In order to do this we made use of a square bank of 1 to 1 ratio transformers connected delta to star, and supplied the load over an existing three-core cable on the 4 wire 3 phase system, using the cable sheath as a grounded neutral, this arrangement being shown in Fig. 6. The arrangement was found to operate so successfully that it was continued in service, and later on, when the entire system was adopted as standard practice, the three phases being run to the approximate load centre and each phase taken off as a single section supplying one particular area in which all secondary mains were interconnected. This gave three large single phase networks on each three phase outgoing feeder, each section having a transformer capacity of from 150 to 300 kw.

In several cases bad breakdowns were caused by the breaking of the neutral conductor or the four-wire primary system, resulting in voltage distortion on the separate phases.

This was overcome, as a then temporary expedient, by tapping the primary neutral to the secondary neutral at two or three points, as in Fig. 7,

Now study this drawing carefully and what do we find? There are two wires of the system covering practically the same area, on the same poles, of same normal potential to earth, and electrically connected together. Is there any good and sound reason for keeping them separate? Why not run one wire to replace the two? This is exactly what we did, and forms to-day what we know as the "Common Neutral System of Distribution." Fig. 8 shows this system as now operated, and in all its simplicity and, perforce, reliability.

By reference to this drawing you will see that we have but one wire to our primary system, with one-half the copper investment and considerably less than one-half the

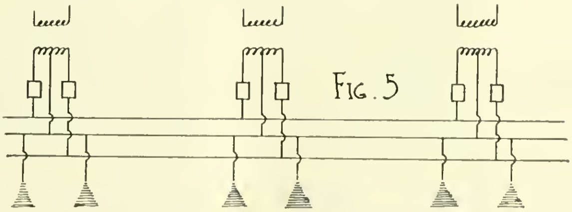


Fig. 5

chances for trouble. But one single pole section control switch and one primary fuse block at each transformer, giving an additional saving in investment and lessened chances of trouble in direct proportion to number of contacts through which current must pass.

On the secondary or low-tension side of the system we find no death-traps for our linemen, in the form of ground wires uninsulated and attached direct to poles. On the customers' service the neutral service fuse is either omitted altogether or permanently bridged. This is of particular ad

vantage where three-wire services are taken off for larger customers; as, in such cases, a blown neutral generally means a lot of burned out lamps—and Tungstens cost money.

Such a system, I believe, approaches very closely the ultimate in economy, efficiency and reliability. It would not be possible except by thorough grounding of neutrals, and, I believe, absolutely wipes out any possible objection to such grounding from the standpoint of expense. Can we, therefore, in any way defend ourselves against the inevitable consequences of non-grounding after it has been shown that in protecting the lives and property of our customers, we at the same time save ourselves a very considerable proportion of our present and prospective investment?

I would suggest that the various inspection bureaus give this question their careful attention with a view of officially recognizing it as standard practice. The inspection bureaus with which I have had to deal have in all cases unofficially approved of the method above outlined; although it is not in accord with the actual wording, however, it may be in conformity with the spirit of the Code or Provincial Rules. In other words, instead of the established rules leading the

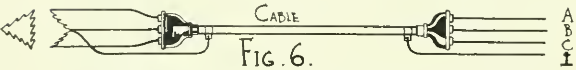


Fig. 6.

system, the system is leading the rules, and the shorter we can make the drag rope the easier pulling we will have.

As a final suggestion, allowing that our neutral is so solidly grounded that it would be almost an impossibility to clear the grounds from it, are we not wasteful in our methods of interior wiring, as well as getting a final installation at maximum cost and minimum reliability?

For instance: What do we gain by putting high-grade rubber insulation on a wire that is permanently operated grounded, and can be operated in no other way? Why not simply give it a single braid weatherproof covering to prevent corrosive action only and not as electrical insulation in any sense?

Why do we run our common neutral into a building and then split it up into numerous small branches paralleling each other throughout most of their length? Why not

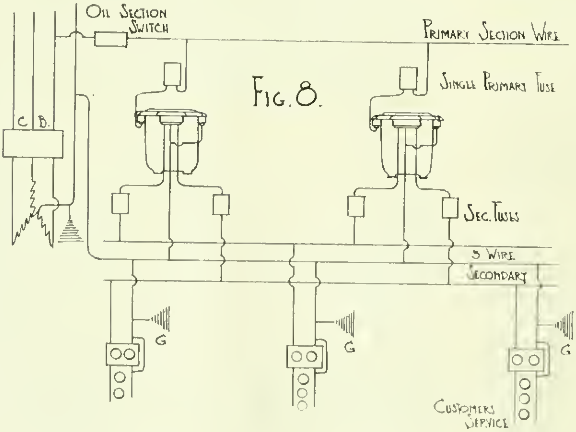


Fig. 8.

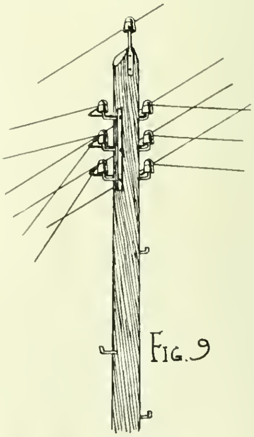


Fig. 9

make this a common conductor throughout the installation and not only save wire but save 50 per cent. of our losses in the branch wiring?

Why should we encourage this waste by going even further and protecting each of these split neutrals with a fuse, knowing that the blowing of this fuse is already responsible for many, if not most, of our interior wiring failures?

If we ground this interior common neutral at numerous places, when it is installed, we absolutely prevent its ever being used for any other purpose but that of a grounded

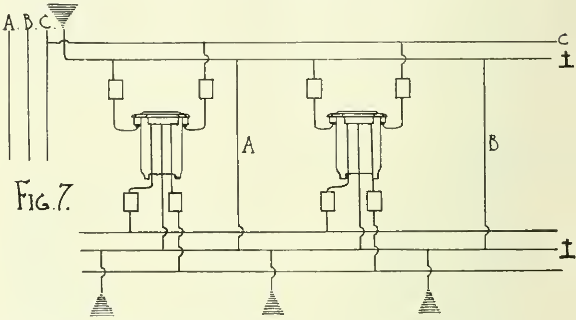


Fig. 7.

neutral. We need no disconnecting or protecting devices, for the good and simple reason that it neevr needs testing or protecting.

With such a system we can easily cut our installation costs from 15 to 25 per cent. and our maintenance costs by even a greater amount.

As a paper of this kind would hardly be complete without touching on the question of grounding of circuits whose voltage is higher than that of an ordinary secondary distribution system, I will transgress a few moments more on your valuable time in an endeavor to give you a brief outline of my experience and convictions as to these higher voltages.

There are two factors which enter into the grounding question: First, the life hazard; and, second, the reliability of operation, under which also comes the fire hazard.

Taking up the life hazard, this may be considered as applying only to circuits of from 150 volts to 6,600 volts, as above this voltage it is not good practice to attempt to work upon live circuits.

As to what is a fatal voltage is an open question, and one which depends entirely upon the condition under which one may make contact with the circuit. Numerous cases are on record where shocks from 110 volts have proven fatal; and, on the other hand, shocks at voltages as high as 60,000 have not proven fatal.

In the writer's opinion the whole question of fatality

depends on surface contact resistance, and the actual voltage is far from being the governing factor. By the use of an ordinary megger I have made resistance tests of the body and have gotten readings of from 4,000 to 40,000 ohms under different conditions of skin moisture, these tests being made with ordinary voltmeter contacts used as electrodes, giving probably one-half square inch surface contact. Under similar conditions I have found that the resistance between two fingers of one hand is practically identical to that between two fingers of opposite hands, showing that the body itself is of very low resistance and that practically all the resistance is in the skin itself. We can make a number of deductions from these tests. For instance: A shock from one hand to the other will paralyse the lungs before it will affect the heart. One from either hand to the head will produce unconsciousness before affecting any other part of the body. From one hand to any point below the heart line, but on same side of the body, will produce muscular contraction of a severe nature without necessarily affecting either the heart or lungs. From one hand to opposite side of the body below the heart line will pass current directly through the heart and produce fatal results in the majority of cases. The tests also show that a fractional part of an ampere will, and has, produced fatal results.

With such a widely varying factor entering into the problem, it becomes impossible to draw any line where we shall or shall not ground. For this reason the writer advocates grounding, and grounding solid all distributing and transmission systems irrespective of the operating voltage. We know that up to 250 volts grounding is desirable. On a large 550 volt 3 phase network, supplied from star connected transformers, the neutral has been grounded for several years with a vast improvement in operating conditions over the former delta connected ungrounded network. In the ungrounded system it was found to be utterly impossible to keep the network free from grounds for any extended period; consequently, it was a selection between getting a probable shock at 550 volts and a certain shock at 330 volts. At the lower voltage condition pressure to ground was fixed and always known, consequently could be easily avoided.

At 2,300 to 4,000 volts I have already shown that grounding has been found to be very desirable from an operating standpoint. As to the life hazard, practical operation with such a system has shown that the fatalities have been at least no greater, and probably less, from the grounded system at the higher voltage than from the old ungrounded delta system. The answer to this is, I think, found in the knowledge of all the men working on such a system that they must take precautions which they should take on an ungrounded system which may develop a ground on any wire at any time.

As an illustration of the improved operating conditions obtainable from a common neutral grounded system, this system has passed through a very severe lightning storm with practically no damage or interruption; while a delta connected system with no primary grounds, and covering exactly the same territory, went absolutely out of business and required several days to get back into normal operation.

This common neutral system has from time to time become crossed with every class of circuit adjacent to it, including 600 d.c. trolley and 60,000 volt transmission, and has come through with all flags flying every time.

On the higher transmission voltages, grounding is, to my mind, equally desirable. The strain on insulators is always to ground and not from line to line. True you have two sets of insulation to depend on in an undergrounded system; but, if we are to believe advocates of non-grounding, the advantage of an ungrounded system is the ability to operate with one line grounded. If this is admitted, of what use is our double insulation if we can limit our maximum voltage to ground to 58 per cent. of operating voltage by grounded star connection?

In a recent report in one of our technical journals, covering 54 systems operating at high voltage, it was shown that 56 per cent. of these used star connection either wholly or in part. Of these but 16 per cent. operated ungrounded, and 37 per cent. operated with solid neutral grounds and the balance through resistance ground. This shows that I am not by any means alone in my contention, and it is my belief that every one of these systems could improve their operation by grounding. Of those operating delta connected I further believe every one of them could star their trans-

(Continued on p. 55)

Table 1.—Cost figures on representative menus (See p. 38)

	Breakfast	Food	Dinner	Food	Supper	Food
	KW.H.		KW.H.		KW.H.	
Mon.	.657	Oatmeal, Dropped Eggs on Toast, Toast, Coffee	1 219	Pork Chops, Fried Apples, Boiled Potatoes, French Toast, Sauce for French Toast, Coffee	1.338	Omelet, Fried Potatoes, Muffins, Tea, Preserves
Tues...	.366	Corn Flakes, Fried Eggs, Toast, Coffee	3 085	Roast Beef, Mashed Potatoes, Baked Macaroni, Caramel Pudding	1.030	Creamed Codfish, Pop Overs, Preserves, Tea
Wed.	.581	Oatmeal, Meat on Toast, Toast, Coffee	1 318	Soup, Steak Broiled, Steamed Potatoes, Vegetable Salad, Suet Pudding, Coffee	.934	Beef Warmed Up, Boiled Potatoes, Bread, Tea, Cake
Thurs...	.948	Corn Flakes, Fried Bacon, Fried Eggs, Muffins, Coffee	1 424	Lamb Chops, Creamed Potatoes, Green Peas, Apple Pie, Coffee	.460	Baked Beans, Toast, Sauce, Tea, Cake
Friday...	.713	Oatmeal, Hash, Toast, Coffee	1 071	Tomato Soup, Fried Ham and Eggs, Mashed Potatoes, Turnips, Coffee Jelly, Coffee	1.302	Creamed Beef, Fried Potatoes, Toast, Tea, Layer Cake
Sat.	.618	Cornflakes, Fried Smelts, Toast, Coffee	1 393	Boiled Halibut, Egg Sauce, Steamed Potatoes, Stewed Tomatoes, Pie, Coffee	1.192	Scrambled Ham and Eggs, Cranberry Sauce, Biscuits, Tea, Layer Cake
Sun.	.610	Pork Chops, French Toast, Coffee	4.019	Roast Turkey, Cranberry Sauce, Potatoes, Onions, Suet Pudding	.741	Cold Roast Turkey, Biscuits, Tea, Cranberry Sauce, Pork Cake
	4.493		13.559		6.997	

Total K.W. Hours for seven days 25.049

Legal Aspect of Company Interference

By G. H. Montgomery, K. C.*

While the American Reports are full of cases dealing with this important subject, very little attention has been paid to such Canadian cases as have been decided, and as the subject is one with which an operating man is in daily contact, the writer has felt that a few notes upon such of the Canadian cases as have come under his attention would be of interest to the members of this Association.

In large centres, particularly where telephone companies, telegraph companies, tramways and electric light companies, and frequently competing systems of each, are compelled to occupy the same streets, and more particularly where the greater part of the construction is overhead, conflict is bound to arise, and the Courts have on a number of occasions been called upon to settle the difficulties between the several holders of conflicting franchises. While the guiding principle has been and should be the reconciliation of franchises so as to permit the operation of all and to prevent anything of the nature of exclusive occupation on the part of any one franchise holder, it is obvious that in the majority of cases superior rights must be conceded to one or the other. As a general rule, priority of occupation will give such superior rights, and any company going into a field already occupied by another company operating an electrical franchise will be held to respect the rights of the prior occupant and to so arrange its system as not to interfere with that of the earlier occupant. This principle, however, suffers certain exceptions either by reason of the nature of the franchise or having regard to the reasonableness of the occupation or the system employed by the first occupant. Deiser, in his work "Law of conflicting Uses of Electricity and Electrolysis," has summarized the principles as follows:—

"The street railway is a dominant franchise in city streets. It is a burden upon country highways.

"The construction and operation of the street railway cannot, in normal cases be enjoined by any other franchise holder, merely because the exercise of the franchise is harmful to it.

"Telephone and telegraph companies may procure a certain degree of immunity from disturbance through induction by using the McCluer device or the complete metallic circuit. Such a company therefore can obtain no relief from the courts unless it can show that it is maintaining its plant at a state of efficiency consistent with modern development in electrical apparatus. The Canadian cases suggest a test in this connection that seems final. A company not making use of such appliances is certain to be disturbed sooner or later by some electrical franchise, street railway, electric light or electric power. It cannot hope to exclude forever all other franchises from its territory merely because it fears disturbance when it has voluntarily kept its own apparatus at a low state of efficiency.

"All direct trespasses may be restrained. All wanton trespasses may be restrained. It is probable that the direct injury of apparatus or property by escaping currents of electricity is actionable both in England and the United States.

"The location of wires and other apparatus will almost invariably be controlled in such a manner as to harmonize the operation of both franchises."

Bell Telephone vs. M. S. R.

These principles were applied by the Quebec Courts in the case of The Bell Telephone Company vs. Montreal Street Railway Company, Official Reports 6 Q.B., page 223. There, it was held by the Court of Queen's Bench:

"The dominant purpose of a street being for public passage, any appropriation of it by legislative authority to other objects will be deemed to be in subordination to this use, unless a contrary intent be clearly expressed. So, where the operation of a telephone service worked by the earth circuit system, was interfered with by a street railway company's adoption of electricity as its motive power, it was held that the telephone company having no vested interest in or exclusive right to the use of the ground circuit or earth system as against a street railway company incorporated by statute, the telephones company could not recover by way of damages from the street railway company the cost of converting its earth circuit system to what is known as the McCleur or common return system—a change which was rendered necessary by the street railway company's adoption of electricity as its motive power."

The judgment of Davidson, J. (now Sir Charles Davidson, Chief Justice of the Superior Court), which is confirmed by the Court of Appeals, lays down the following principles, viz.:—

"Considering that the dominant purpose of a street is for public passage, and that the privileges exercised by defendant expedite public travel and promote the public use to which streets are devoted;

"Considering that while plaintiff is permitted to construct telephone lines along the sides of and across or under the public highways, these lines must not interfere with the public right of travelling on or using such highways (43 Vic., Ch. 67, Can. 1880), and that the business of telephoning while working for the public benefit is an object which must be deemed to be in subordination to the dominant right of public travel."

Following the same idea, Sir Alexander Lacoste, Chief Justice of the Court of Appeals, said:—

"The Appellant (The Bell Telephone Company) invokes the priority of its franchises over that of the Respondent. . . . . but we should remark that the Appellant by its Charter has only a restricted privilege in the streets. It cannot interfere with the public in the use which it wishes to make of them. The streets are above all for circulation, either on foot or in vehicles, and the establishment of a railway for the carriage of passengers, whatever may be its mode of locomotion, is an ordinary use of the streets. To prevent the establishment of a system of transportation of this nature would be to diminish the rights of the public. Without doubt, a railway should avoid as far as it can reasonably do so causing any damage to the telephone company, but it is for the latter to protect itself and to accommodate its system to the inconveniences which are inevitable."

Bell Telephone vs. Belleville Electric.

On the other hand, in an earlier Ontario case between the telephone company and an electrical company (Bell Telephone Company vs. Belleville Electric Company, Queen's

*Read before the Montreal C. E. A. Convention.

Bench Division, 12 Ont. Reports, page 571) the earlier occupation by the telephone company as giving a priority of privilege was maintained. There, the Court said:—

"It appears the plaintiffs were in possession of the ground for the erection of their poles, and that they had their poles erected about two years before the defendants put up their poles. That, however, did not give them the exclusive possession or right to use the sides of the roads on which they had placed their poles, even if they had the independent right to use the sides of the roads under the Dominion Act, without the consent of the municipal council. It is not necessary to say whether the Dominion Act or the Provincial Act is the Act under which the plaintiffs had the right to exercise their powers—that is, whether they have the right to use the road sides for their poles without the leave of the municipality, or only with such leave according to the Ontario Act.

"It is sufficient to say that being in the earlier possession of the ground required for their poles the defendants have not the right to interfere with or do any act to the injury of the plaintiffs' earlier right. The defendants would not have the right to cut down or remove the plaintiffs' poles, nor to make use of them, nor to place wires or do anything else which would damage the purpose or usefulness of the poles or wires which the plaintiffs had placed there; nor to render useless or prejudice the business which the plaintiffs were and are authorized to carry on by means of their poles and wires; nor to cause danger to life or property by stringing their wires so near to those of the plaintiff that life or property is endangered thereby."

C. P. R. vs. Falls Power Co.

A somewhat similar decision was subsequently rendered in December, 1907, by Mr. Justice Riddell in the High Court of Ontario in injunction proceedings between the Canadian Pacific Railway Company, et al. vs. Falls Power Company. There, the C. P. R. and the Bell Telephone Company had been using the same line of poles in the Town of Welland for the carriage of their telegraph and telephone wires. The Falls Power Company having received permission from the Town by By-law, commenced the erection of a line of poles through the telegraph and telephone lines with the intention of overbuilding the latter and carrying distribution and transmission wires of 2,200 volts and 12,000 volts respectively over the telephone and telegraph wires. In some cases it was proved that the poles actually touched the existing wires. Mr. Justice Riddell found upon the evidence that it would be certain to cause substantial interference not only from the leakage during the wet weather, but by reason of the fact of the linemen being obliged to ascend from time to time through the telephone and telegraph wires. He also found upon the evidence that there was grave danger of the high voltage wires falling upon the telegraph and telephone wires. Upon this finding on the facts he held that the permission granted by the Municipality was not sufficient answer to the complaint made by the telegraph and telephone companies, and that no power exists by which a Municipality under the Ontario statutes can permit one company to interfere prejudicially with the property of other companies. He accordingly granted an injunction restraining the defendant from erecting or maintaining poles for the carriage of wires intended for conducting electricity in a line with and between the poles of the plaintiffs or either of them, and stringing wires thereon over or parallel to the wires of the plaintiffs or either of them, and also directing the defendant company to remove the poles already erected.

Jacques Cartier W. & P. vs. Q. R. L. & P.

As between competing electric companies, what is known as "the three-foot rule" has been laid down and more or less consistently followed by the Courts of the Province of Quebec. This rule is first found in that Province in a very elaborate judgment delivered by the Court of King's Bench in the case of the Jacques Cartier Water & Power Company vs. the Quebec Railway, Light & Power Company, Official Reports 11 K.B., page 511. **Held,** reversing the judgment of Andrews, J.

"1. When the Legislative authority gives to two or more companies similar powers to be exercised in the same territory, the Courts must necessarily conclude that the Legislative power in question wishes to give them concurrent powers; in such a case, the Courts being bound to submit to the Legislative power, should not intervene between these several companies except when one of them trespasses upon the acquired rights of the other.

"2. Three feet seems to be, according to the experts or connoisseurs in the matter, a sufficient distance to avoid all immediate danger."

In the Lower Court Mr. Justice Andrews had gone very much further, and after referring the case to experts he had ordered the defendant company, which was the later in occupation, to remove its wires, upon the ground that the suggestions made by the experts for the diminishing of the danger involved such an interference with the property, poles, wires and appliances of the plaintiffs as rendered their suggestions impossible of adoption, and that their adoption would not in all cases protect them from danger and detriment.

His opinion was shared by Mr. Justice Cimon in the Upper Court, who held that the rights of the first Company comprised not only the space occupied by its poles and wires, but also for the purposes and during the existence of its line "all the space upon the earth and in the air reasonably required for the maintenance and exploitation of this line." He also denied the right of the second company to attach the wires of the first company to its posts by means of insulators.

The majority of the Court of Appeals, however, held that it was the duty of the Court to reconcile the two Charters, both having been granted by the Legislature, and in consequence modified the judgment to the extent of obliging the later Company to move all posts and wires which were less than three feet from those of the earlier company. The majority agreed, however, with the opinions of Andrews, J., and Cimon, J., to the effect that they could not oblige the earlier company to attach or allow its wires to be attached to the poles of the later company. This case was decided in 1902.

Montreal L. H. & P. vs. Maisonneuve.

This "three foot rule" was subsequently followed by Mr. Justice Charbonneau in 1910 in a case between The Montreal Light, Heat & Power Company, the Town of Maisonneuve and the Dominion Light, Heat & Power Company, where the Court on demand for an injunction enjoined the Dominion Light, Heat & Power Company "from placing any poles, wires or other apparatus within a distance of less than three three feet from the poles, wires and other apparatus of the company petitioner."

On a subsequent application in the same case made in February, 1911, upon the company petitioner's complaint that the respondent company had violated this order by running its poles through the wires of the first company and overbuilding its lines, the Court held that it was impossible to permit the building of one aerial line over another, without at the same time authorizing one of the two companies to make use of the apparatus of the other company, or without establishing a joint use of the same apparatus, the word "apparatus" evidently being used to mean poles. The Court held that it had not the power to order such a species of

partnership or to create a servitude upon the poles and wires of the other company, and accordingly ordered the removal of the poles and wires complained of.

In a later case decided in the same year by Mr. Justice Davidson between The Montreal Light, Heat & Power Company and the Montreal Electric Company, the Court held that the fact of running poles through the earlier wires or attaching side blocks to the earlier poles constituted such an interference with the petitioning company's rights as to entitle the latter to protection:

"I entirely adopt the remarks made by Andrews, J., in the Jacques Cartier case at page 524. He said that when an electric company is in occupation of streets or portions of streets or public places of a city prior to the advent of another electric company, such prior occupation, while not creating exclusive rights, is entitled to protection and to maintenance so far as such possession is a reasonable one."

The order of the Court ran as follows:—

"Firstly, doth order and enjoin the respondents:

"1. Within one month from the service upon them of the present judgment to remove:—

"(a) all poles which project through the wires of petitioners;

"(b) all wires whether primary or secondary (the latter term including wires from transformers into buildings and wires carrying less than 600 volts) which are within 3 feet of the primary or secondary wires of petitioner's existing system;

"And in default of the respondents complying with the foregoing order, within two months of the service upon them of this judgment, doth authorize the petitioner to cause the same to be removed at the cost and expense of respondents.

"Secondly, the court doth enjoin and restrain the respondents.

"(a) from erecting poles projecting through the wires of petitioners;

"(b) from running wires or transmitting electric currents, whether primary or secondary, at a less distance than three feet from the primary or secondary wires of petitioner's existing system.

"Thirdly. Doth reserve to the respondents the right to apply to the court in respect of any places or localities where the petitioners occupy both sides of the streets when one side would suffice, or where some unimportant change in the position of petitioner's poles or wires would obviate the otherwise complete blocking of the streets, to the end that in such cases the court may order as to law and justice may appertain."

Chambers Electric vs. Town of Truro

The principal that the occupation of the first Company must be a reasonable one, and that it will not be allowed to act in such a way as to purposely prevent the latter Company from exercising its franchise has recently been followed in the Province of Nova Scotia in the case of the Attorney-General and the Town of Truro vs. Chambers Electric Light & Power Company, 14 D.L.R., page 883. The summary of the holding in this case is as follows:—

"An electric company will be restrained from arbitrarily and unreasonably lowering its wires for the sole purpose of compelling a competitor, which otherwise could string its wires below the first Company's wires and still leave a clear space of three feet, as required by Section 6 of Chap. 130 of Nova Scotia Acts of 1889, and had begun operations accordingly, to re-arrange its entire plant and go above the first company's wires."

The principle which can be gathered from the foregoing cases is that while it is the duty of the Courts to construct and apply the Charters of conflicting companies of equal authority in such a manner as to harmonize them and permit the exercise of both, that nevertheless the Company which is earlier in occupation is entitled to all reasonable protection and has an acquired right to all the space occupied by its poles and wires to such an extent that a Court is without power to permit a company coming later into the field to make use of the poles and wires of the earlier company even to the extent of attaching side blocks or cross-arms to prevent interference.

Before leaving the question of franchises and charter rights, it may be said that the Courts of the Province of Quebec have held on several occasions that it is quite within the powers of a Municipal Council to grant an exclusive franchise for a fixed term of years. As against this, the Privy Council, held in 1909 that where a Company was incorporated by Provincial Statute with the exclusive right of supplying electricity within a certain radius, that this would not operate against the general powers granted by a Dominion Charter, the holding of the Court being:

"That where a field of legislation is within the competence of both the Dominion Parliament and the Provincial Legislature, and both having legislated, in case of conflict the enactment of the Dominion Parliament must prevail."

The case referred to is that of "La Compagnie Hydraulique de St. Francois vs. The Continental Heat & Light Company, Law Reports, Appeal cases (1909), page 194.

While the principles above given as to the more or less absolute rights acquired by an earlier company were no doubt sound in law they have been considerably modified in practice by the establishment of Public Utilities Commissions in several of the Provinces with wide powers of regulation. In the exercise of these powers such Commissions have in many cases not only permitted but ordered the joint use of poles.

In the Province of Quebec considerable questions has arisen as to how far the establishment of the Public Utlitties Commission with powers conferred upon it has interfered with the jurisdiction of the Courts.

Quebec R. L. H. & P. vs. Dorchester Elec.

In a comparatively recent case of the Quebec Railway Light, Heat & Power Company and the Dorchester Electric Company, Official Reports 23, K.B., page 159, this question came up for the decision of the Court of King's Bench upon an appeal from a judgment of the Supreme Court where it had been held that the jurisdiction of the Courts had been removed. Here, the Quebec Public Utilities Commission had issued a general order respecting electrical conditions in the City of Quebec to the following effects:—

"1. Wires of different companies or persons, whether of the same class or not, shall not approach within three feet of one another, if strung on different poles and running parallel or are crossing. If on the same poles, twenty-two inches will suffice;

"2. At all points of crossings, proper support shall be provided to prevent swinging, or greater distances than those named above shall be observed;

"3. Extra high tension wires must be at a minimum distance of at least five feet from any other wires;

"4. No wires other than low pressure and signalling wires shall be allowed to approach within three feet of any part of any building, unless required to enter the same, and shall be securely fastened and insulated, if attached to any part of such building by supports of any kind."

The plaintiff company applied to the Superior Court for an injunction, claiming that this order had been violated by the defendant. An exception was taken to the jurisdiction of the Court, and this exception was maintained in the

(Concluded on page 55)

Progress of the "Safety First" Movement

By J. F. H. Wyse, Organizer and Engineer, Ontario Safety League*

"The term, "Safety First," is said to have been originated by the United States Government, in a nation-wide movement, during 1908, to reduce accidents in coal and metal mines. It is estimated that there were, during the years 1908-9-10 and 11, on account of this campaign, 51,400 lives saved.

"Safety First" is the slogan under which many Safety Leagues, Safety Committees and Associations of to-day are conducting vigorous campaigns for the prevention of accidents.

The movement is almost universal (at least as far as civilized countries are concerned). Its objects are good—the saving of life and limb.

HISTORICAL.—For centuries the ingenuity of man has sought out many inventions to perfect machines for almost every conceivable purpose; however, neglecting the greater care and conservation of the finest machine of all, namely, the human being. To produce the finished article, the laborer, the mechanic, the artisan, the engineer—in fact, all the human element used in factories of every description—had been, up to recently, seriously neglected. The wonderful human machine and its care had been held cheaper than the mere mechanical device.

We have to give the little country of Holland the credit for taking the initiative in accident prevention, in a crusade for human safety and for setting the whole world an example in this laudable work. In the year 1893 a few enthusiasts rented a small dwelling, and secured and placed therein some photographs, models, drawings and actual machines, with devices and attachments, showing their dangers and how to avoid these dangers in operation. At the present time this organization occupies a new and commodious building in Amsterdam, opposite the Rjyks Museum.

Berlin was the next to fall in line, and in 1903 established a Museum of Safety Appliances, which stimulated the public interest. Such success was attained by these museums that the Government soon took them over and looked after their maintenance and enlargement. To-day this Berlin Museum is said to be the finest of its kind in the world.

Shortly afterwards Germany established similar museums in Munich and Dresden, and to-day Germany is said to have solved the great problem of public safety. What Germany has done, we have yet to accomplish.

The American Museum of Safety, with its head office in New York City, established in 1908, is a vigorous child of this Dutch and German parentage. There are now, at the following places, some twenty-two, or more, of these institutes for the promotion of Safety and Hygiene—Amsterdam, Berlin, Barcelona, Brussels, Budapest, Copenhagen, Dresden, Frankfort-on-the-Main, Gratz, Helsingfors, London, Milan, Moscow, St. Petersburg, Stockholm, Vienna, Wurzburg, Zurich, Paris (two), New York City, and, last but not least, Montreal."

"In the Industrials of Europe it is conservatively estimated that the "Safety First" movement has reduced accidents at least 50 per cent, and the work has been done with the firm belief that "Every life saved is a national asset."

Expenses caused by accident are a burden to the taxpayer, and saving along these lines is a "balance on the right side of the ledger."

Dr. Zacher, Director of the German Imperial Bureau of Statistics, makes the following statement:—'One billion marks (nearly $250,000,000) is saved in wage-earning efficiency annually in Germany through our sanatoria, museums of safety, convalescent homes and other forms of social insurance, by which we safeguard the lives and limbs of our workmen, and prevent the cause and effects of disease, which would lessen their economical efficiency. Some of our industrials and manufacturers are waking up to the fact that prevention of accidents pays, and that it is far cheaper and more economical than compensation.'

Dr. Tolman, Director of the American Museum of Safety, and author of a volume entitled "Safety," to which I am indebted for much information contained here, says:—'A recent case brought to light the fact of how one manufacturer, after the inspector's report had been received, left a floor pit uncovered. Shortly afterwards a workman fell into it, and received $15,000 damages. Literally, a wooden hand-rail at the top of this precipice would have cost $5; the ambulance at the bottom cost $15,000.'

In Germany every employer must belong to the trade association of his business. He pays to this association an accident premium, which is an insurance of his workmen's safety, and he, the German employer, knows, after twenty-five years' experience, that any accident is sure to be thoroughly investigated, and the first question asked will be, 'Was there a proper safeguard provided?'"

"Many railways and street railways in the United States and Canada have organized a safety movement to conserve, not only the public, but their own employees. The results have been so successful that it is said, 'Once a 'Safety First' movement is started, it is never abandoned, but goes on increasing its work and widening its scope.' One of these railroads saved one hundred and seventeen lives and seventy-five hundred injuries in a campaign of some forty months; and a street railway, by letters to automobile owners and teamsters, reduced its street traffic accidents in one month about 40 per cent."

"Based upon accident prevention work in the United States, and what they have accomplished, similar work in Canada would effect a vast economical and social saving.

Money is being freely spent by our Governments on Forests, Game and Fisheries, while our wage-earners, when hurt through avoidable accidents, become a burden upon the taxpayer and objects to charity. Would not some of the public money spent to prevent these accidents be a good investment? Educational and legal prevention of accidents and disease by sanitation is better and more economical than the cost thereof after accidents have occurred. In other words, 'An ounce of prevention is worth a pound of compensation.'

It becomes more easy to obey rules for safety when their importance and wisdom is realized than if they are to be regarded as mere rules. We must wake up here in Canada, as they have done in some other parts of the world, to the subject of conservation of human life and limb.

There is nothing in the 'Safety First' movement of a political or partisan nature. Its aims are to invite all creeds, parties and interests in a universal endeavor to safeguard life and limb. The work is in no sense revolutionary, but proposes to accomplish its objects by sane and conservative methods; to make suggestions, to give warnings, to get the co-operation of all the people all the time, and to secure their moral and financial support as an investment that has paid, and will still continue to pay.

The Ontario Safety League, formed at the suggestion of the Ontario Railway and Municipal Board, is conducting a vigorous campaign against street accidents. It is almost solely educational, and for ways and means is entirely dependent upon public subscription.

* Read before the Montreal C.E.A. Convention.

Reflection in Submarine Cables

By L. P. Crim, B.C. Telephone Co., Vancouver, B.C.

The recent laying by the British Columbia Telephone Company of a submarine telephone cable between Point Grey and Nanaimo together with the land connections, makes possible the establishing of a continuous telephone circuit from Vancouver via Nanaimo, Victoria and Bellingham (Wash.), back to Vancouver. This circuit passes through the two principal submarine cables owned by the company and makes an excellent circuit on which to study the effects of reflection at the cable ends.

The cable between Bellingham and Victoria is of the 4-core gutta percha insulated type for use in deep water. The copper conductors weigh 180 pounds each per naut. and are each insulated with 180 pounds of g.p. per naut. There are about 14.7 nauts. of this cable in five pieces varying in length from 0.25 to 8.0 nauts.

The Point Grey-Nanaimo cable is of the continuously loaded type and has stranded copper conductors weighing 300 pounds per naut. which are each insulated with 300 pounds of g.p. per naut. A complete description of this cable is given in the A.I.E.E. Proceedings, Vancouver Branch, September, 1913, pages 1819-1831 inclusive, and an interesting account of the laying operations appeared in the Electrical News previous to that date.

It was found that the reflection losses in the physical circuits of the Bellingham-Victoria cable amounted to about 6 miles of standard cable, while in the phantom circuit, the losses were about nine miles of standard cable. The heavy transmission losses in the phantom circuit have prevented its use prior to this investigation.

In the new Point Grey-Nanaimo cable it was found that reflection losses in the two physical circuits were equal to about 3 miles of standard cable per circuit, with about 5 miles loss in the phantom. It is proposed to work a fourth circuit through cable by means of a grounded phantom on the metallic phantom. Investigation has shown more than 15 miles of

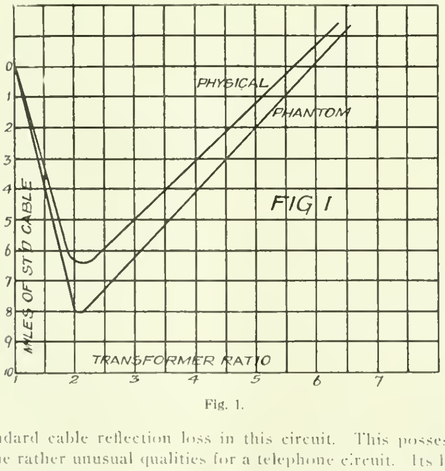


Fig. 1.

standard cable reflection loss in this circuit. This possesses some rather unusual qualities for a telephone circuit. Its loop resistance (total) is about 32 ohms (including terminal transformers), total capacity about 39.6 microfarads, the total indrctance about 39.2 millihenrys, with a total leakance of about $11.20/10^4$ mhos.

Much has been written by the theoretical investigators concerning reflections of waves in passing from one portion of a circuit to another of different surge impedance, but there seems to be little or no published record of experimental research in this direction. The surge impedance for a telephone circuit may be likened to the diameter of a long speaking tube. If the diameter of a long speaking tube increases suddenly and continues at the larger size for say 200 feet and then is suddenly reduced to a comparatively small diameter again for the rest of its length, it can readily be understood that sound waves passing through the tube will be partially reflected at the square ends where the tube changes size. If these partial reflections exist to any great extent the speaking

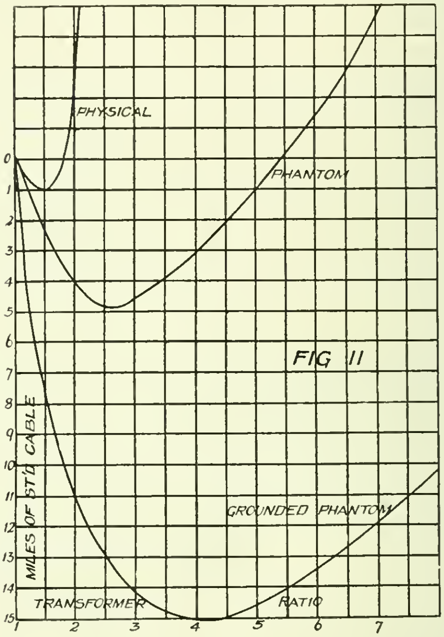


Fig. 2.

qualities of such a tube will not be good. The surge impedance of a telephone circuit is the proportionality factor between voltage and current of the travelling electric waves. As these waves constitute a certain definite quantity of energy, its amount cannot change except by attenuation. Therefore, if the surge impedance of the circuit changes, the proportionality factor between the current and voltage also changes, which is to say that there is a transformation of current and voltage at every point in a circuit where the surge impedance changes. This change in voltage and current sends a reflected wave in the opposite direction to that of the initial wave, the size of which depends upon the sending end impedance of the circuit in either direction from the point of reflection. If these reflected waves are attenuated until they become of negligible size before reaching the receiving end of the circuit, the energy thus reflected becomes lost. As the phenomena of reflection is caused by the transformation of current and voltage due to the change in surge impedance, it is quite logical to assume that this effect may best be overcome by inserting in the line at the junction point a transformer of the proper ratio of transformation. The investigation was therefore conducted along these lines and the attached curves show some of the experimental results obtained.

Fig. 1 shows the variation of transmission equivalent obtained by using transformers of various ratios at the ends of

the Bellingham-Victoria cable. Curves are shown for the physical and phantom circuits.

Fig. 2 shows a similar set of curves for the Point Grey-Nanaimo cable, for the physical, metallic phantom, and grounded phantom circuit.

Fig. 3 shows a set of four curves obtained from the Point Grey-Nanaimo submarine cable, using respectively one, two, three and four cable cores in multiple as one conductor with ground return. The reason for the seeming inconsistency of

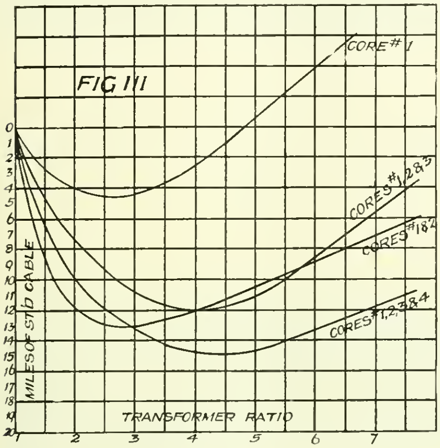


Fig. 3.

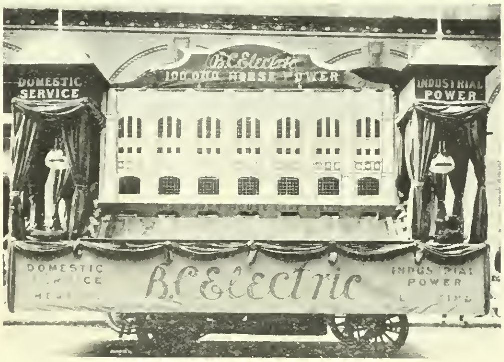
the curve obtained from cores 1 and 2, with respect to the other three, is not apparent.

After obtaining experimentally the ratio of transformation that would give the best transmission in each case, a set of transformers was made and installed at the cable ends. It was found that experimental results checked theoretical calculations as to the transformer ratio required, with a fair degree of approximation.

(Note.—The standard cable referred to has the following properties: $R = 88$ ohms per mile loop, $C = .054$ mf., $L = .001$ henrys, $S = 5/10^6$ mhos.).

Vancouver's Pageant

Among the many fine industrial floats and exhibits represented in Vancouver's first Pageant Parade held on June 12th in honor of the Convention of the Pacific Coast Advertising Men's Association and the British Columbia Lumbermen's Concatenation, none were more spectacular or unique in character than the floats provided by the B. C. Electric Railway Co., depicting the progress that has been in the company's transportation and light and power departments since entering this field. The main feature of the company's light and power float, appropriately labelled "The Source and the Service," was a working model of No. 2 Power House situated at Lake Buntzen on the North Arm of Burrard Inlet. This float measured 12 x 20 feet in size and was mounted on an electric truck, the current from the storage battery being utilized to operate a 3 h.p. motor which pumped water from storage tanks and kept it flowing from the tail races of the power house during the parade. At each corner of the float were small towers each of which was occupied by a person with appropriate equipment representing the applications of electric current to industrial power, lighting, heating and domestic service. The entire float was handsomely decorated in the company's colors of green and gold. Another of the company's exhibits and one which aroused a great deal of interest because of its historical associations was the first street car ever operated in Vancouver, having been placed in service in 1889. The growth of the city's tram service since that year was shown by a banner on each side of the float with



B.C.E.R. Company's parade float.

the announcement: "Vancouver's street car fleet, available 1889—two cars, available 1914—231 cars. Seated on the car were motorman A. Elliott and conductor, J. Jeffers, these being the men in their respective positions now holding first rank as to period of service.

Legal Aspect of Interference (cont. from p. 52)

Lower Court, where it was held that the matter was exclusively within the jurisdiction of the Commission. An appeal was taken to the Court of King's Bench with the result that the decision was reversed by a majority of three to two. The majority of the Court held that the general jurisdiction of the Supreme Court is not taken away by the powers and jurisdiction given to the Commission, except in so far "as public safety and convenience are involved in the complaint or controversy," and that accordingly the plaintiff had a right of action in the Superior Court to restrain the defendant from stringing wires upon or attaching appliances to its poles as well as to have the defendant's wires removed to a distance from the plaintiff's wires sufficient to ensure that the plaintiff's property would not be interfered with.

While the above collection of decisions is not by any means exhaustive of the Canadian cases, except perhaps in so far as the Province of Quebec is concerned, it is the writer's hope that their compilation may be of some assistance to the members of the Association who are called upon to deal with the principles involved, as well as to those whose duty it is to advise them.

Grounding of Distribution Circuits (cont. from p. 49)

formers, ground their neutral, and with same insulators get equally good or better operation and greatly increased line transmitting capacity.

The whole problem of grounding can be summed up in a nutshell. You can easily and economically insulate any circuit for its normal operating voltage, but you can't insulate for any unknown higher voltage, which may be anything up to the highest voltage anywhere adjacent to it. By solidly grounding any circuit you absolutely protect it against any higher voltage circuit with which it may become crossed and absolutely fix your insulation strain to its normal operating value.

Illumination

High Efficiency Lamps

Announcement is made by the Canadian Sunbeam Lamp Company that they are now manufacturing in Toronto, a number of types of high efficiency Mazda lamps. These lamps have a rating of approximately .6 watts per candle and will be manufactured in sizes from 80 candle power up, although at the present stage of development of this lamp the most promising types are the 6.6 amperes, or higher, street series unit, and the multiple type lamps of 750 and 1,000 watts.

The new mazda lamps are made with concentrated filaments. Otherwise they differ from the old mazda lamp in that the bulb is filled with nitrogen gas instead of being a perfect vacuum. The gas contained in the bulb is at approxiamtely atmospheric pressure. Nitrogen is an inert gas so that the filament does not combine chemically with it and the life of the lamp is approximately as long as with the vacuum type.

Increase in efficiency of the incandescent lamp has been limited mainly by the tendency of the filament to volatilize when heated to a very high temperature. This volatilization diminishes both the total life and the useful life of the lamp. The former, because the flying off of minute parts of the filament reduces its diameter and hastens the time when the filament will break at its weakest point; the latter, because the particles of filament that fly off are deposited on the bulb causing the candle-power to fall off considerably during life.

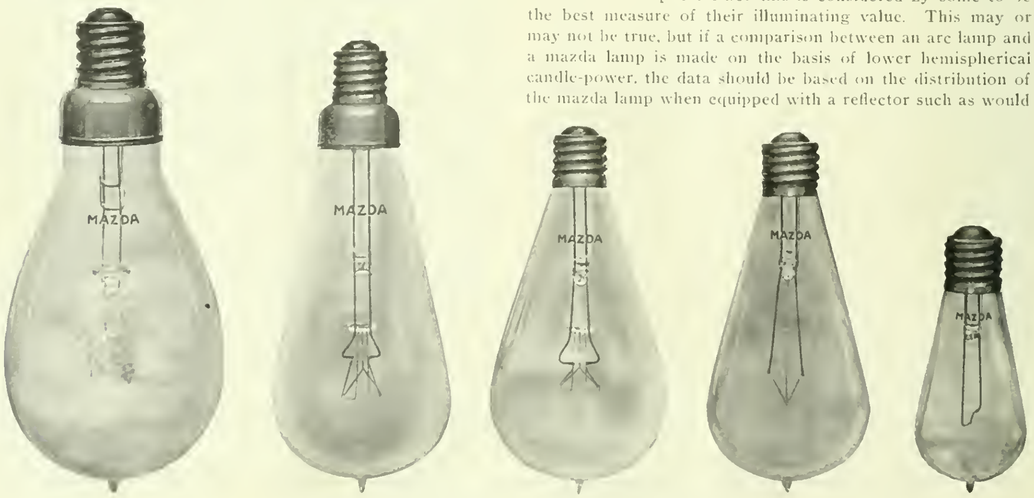
By the use of nitrogen in the bulb this tendency to volatilize is greatly diminished, since all parts of the filament are under atmospheric pressure which greatly raises the temperature of volatilization. This can readily be understood when it is considered that water will boil in a perfect vacuum around 0° Centigrade (freezing point).

At present the new lamps are being made only in high amperages, so that their first appearance on the market is under the street series schedule and under the multiple schedule for lamps of 750 and 1,000 watts. These large multiple lamps have an efficiency of approximately .6 watts per candle. Undoubtedly further developments will make it possible to produce these lamps for lower wattages, especially so in the case of low-volt or compensator lamps.

In operating the lamps it is necessary to exercise great care to insure the current remaining nearly constant, inasmuch as the filament operates at an extremely high temperature and a slight excess of current has a marked effect upon the life.

What One-Half Watt Per Candle Means

The rating of 0.6 watts per candle for an incandescent lamp would at first glance seem to indicate an efficiency 100 per cent. greater than for a standard lamp at an efficiency of 1.2 watts per candle. It must be remembered however that these efficiency ratings apply to the horizontal candle-power only. In the case of standard mazda lamps, the mean spherical candle-power, which is really the measure of the total light, is only 0.8 of the horizontal candle-power, or in other words the reduction factor is 80 per cent. In the case of the new mazda lamps the reduction factor is between 90 and 100 per cent., depending upon the size of the lamp, as shown by light distribution tests just completed. This means that the total light of the new lamps per watt is not merely double that obtained from the older lamps but is in reality considerably more. The ratings which are frequently given to flaming arc lamps and similar illuminants apply not to the horizontal or hemispherical candle-power but to the mean candle-power in the lower hemisphere since this is considered by some to be the best measure of their illuminating value. This may or may not be true, but if a comparison between an arc lamp and a mazda lamp is made on the basis of lower hemispherical candle-power, the data should be based on the distribution of the mazda lamp when equipped with a reflector such as would



Types of High Efficiency Mazda Lamps—From 1600 candle power down.

be used in practice. The present 500-watt mazda lamp at one watt per candle when equipped with the best reflector will give a mean lower hemispherical candle-power of 665 or a hemispherical efficiency of 0.75 watts per candle. Under similar circumstances the new mazda lamp at 0.6 watts per candle would show an efficiency of 0.4 watts per candle. This is far higher than is obtained under working conditions from practically any other form of electric illuminant.

Lawn Tennis at Night

An interesting application of electric light is found in the lighting of lawn tennis courts so that the game can be played almost as easily by night as by day. It is not to be understood that night play in the open is as satisfactory as under sunlight but nevertheless it has been found more satisfactory than artifically lighted indoor play and can be quite enjoyable when the element of novelty is considered.

A large number of tennis clubs in the United States are now playing at night on artificially illuminated courts, the light coming entirely from the sides, from mazda lamps and large angle reflectors. The Lakewood Tennis Club of Cleveland was the first to adopt the system for their courts and the illustration herewith shows an entire absence of shadows

Playing lawn tennis by electric light.

a perfect screening of the light source from direct vision and a surprising uniformity of illumination.

Twenty-four Wheeler 45 deg. angle reflectors with 250 watt mazda lamps were evenly spaced twelve to a side, and suspended 16 feet above the ground from a messenger cable strung over three posts on each side of the court and well anchored. The high wire netting, stretched around the court to prevent the balls from being knocked out of bounds, also served to protect the lamps and reflectors from stray balls. In later installations as few as six units have been used to a side, but eight are as few as should be used to give adequate illumination without shadows.

The general success of "night tennis" may be judged by the following comment of the American Lawn Tennis Magazine. "That this system, though apparently simple, is decidedly practical, no shadow of doubt should longer exist. The only phase which I would class as a disadvantage is an initial strangeness during a few games or possibly a set. Directly this has been dispelled, as it does become with but few exceptions, the game may proceed at ever so fast a pace and still be free of more than the ordinary run of uncertainty.

Lobs of whatever height or depth are played without trouble. Services are also, after a time, readily followed. Low volleying both "across court" and at "short" range may be executed with sufficient precision. We gave this matter a very good test (in this respect) when we had our night tournament. We had about fifteen players, representing all the different clubs of the city, play in this tournament, and none of these players had ever been on our courts before, or had ever tried playing at night. There was not a person who had any complaint against it, and, as you will know, if there are any faults in anything, it doesn't take a tennis player very long to state his opinions."

Lighting Stock Quotation Boards

By J. L. Stair

The first requirement to be met in a special lighting problem of this kind is that of providing even illumination over the entire surface of the board, so that figures and quotations may be as easily seen at the bottom of the board as at the top. Again an intensity of illumination must be provided sufficient to enable the marks on the board to be seen from any part of the room. It is very desirable also to so arrange the lighting system, that no lamps or reflecting equipment are visible, since nothing can be more uncomfortable than to attempt to watch the operations of the stock quotation board, with numerous glaring lamps in plain view.

A well lighted Quotation board.

Ordinarily there is a waste of current in the lighting of quotation boards; more lamps are used than are necessary. This waste can be easily eliminated by using care in the selection and placing of lamps and reflectors. In the installation shown herewith the requirements for good lighting have been admirably met. Note with what distinctness the figures on the board stand out, and how well the bottom of the board is illuminated. The question of concealing the lamps was simplified by the fact that a beamed ceiling was used in the room, it was only necessary to build in an additional or false beam near the board and parallel to it. This beam, which is in reality only an apron, is about 3 ft. from the wall, and drops down in front of the conduit and reflectors which direct the light upon the board. The beam is finished in mahogany to conform with the woodwork and trim, and at the rear of the room is easily mistaken for one of the beams making up the ceiling construction. In this installation the X-Ray scoop reflector was installed, spaced about 2 feet apart, with 60-watt mazda lamps burning in a pendant position.

Mr. Wm. C. Wilson, of The Wilson-Carr Manufacturing Company, 45-7 Elm street, Toronto, manufacturers of lighting fixtures, announces that he has purchased the interest held by his partner, Mr. E. S. Carr, and will, in future carry on the business under the name of The Wilson Brass & Copper Manufacturing Company.

The Dealer and Contractor

Writing Electric Specifications

This is the age of specialization. Keen competition necessarily makes it so. It follows that there are few men who can hope to become proficient in more than one line of trade and so, the better class of architect and contractor is coming to recognize that the electrical field is one they can not hope to cover unless indeed they have attached to their staff a department that specializes on this particular section of construction work.

The electrical specifications of a decade ago were considered to have satisfactorily covered the field if the simple statement was made that an electric light system would be installed, but the last few years have seen many changes in this direction. The requirements of the present day, which demand the greatest possible efficiency in every direction have resulted in the recognition of the value of a thoroughly safe and permanent distribution layout of both light and power. So it has come about that the writing of specifications for an electric plant whether for power or light, or both, has become a branch of the work which can only be properly taken care of by the skilled electrical engineer.

This work of the engineer must now be considered as distinct from the work of the electrical contractor as the architect's work is distinct from that of the building contractor. It is true that many an electrical contractor both designs and installs, just as even yet we have horrible examples of the building contractor who architects his own buildings, but the result is often equally disastrous and with the rapid developments and increased requirements in electrical work threatens to become more generally the case. The exception is the few rare cases where an eletrical contracting company are sufficiently strong to include on their staff a skilled designing engineer. Generally speaking, the need of specialists to prepare electrical specifications is becoming every day more necessary and, we are pleased to note, more and more apparent.

As an example of what has been accomplished in the way of proper electric specifications by one consulting engineering firm we print herewith a copy of the specifications for a large new seven-storey building in the central section of Toronto. In addition we commend them as a basis for the electrical contractor who is still in the position of having to prepare his own plans and specifications. We print also in connection with this piece of work a plan of the ground floor, which is to be used for office purposes. This floor is typical, however, especially as to the supply of power. We are indebted for these details to the firm of Ewart & Jacob, electrical engineers, Toronto, who specialize in this particular line of work.

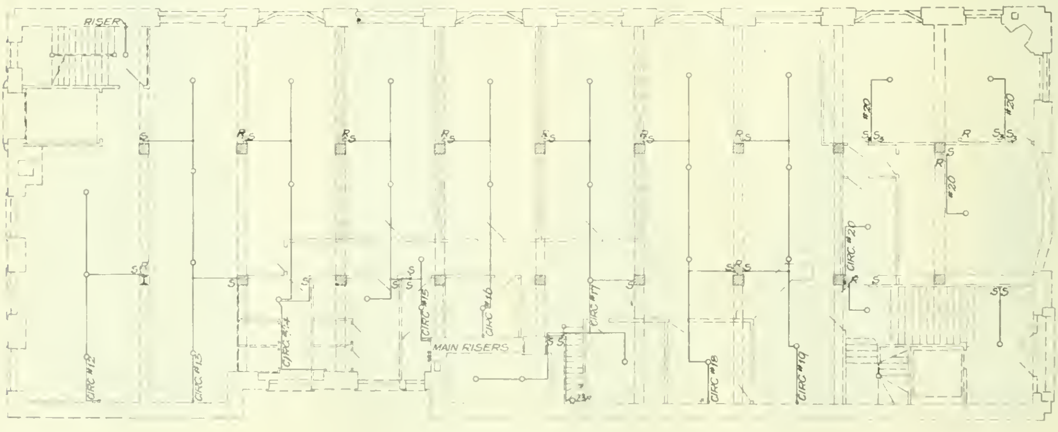
SCOPE OF INSTALLATION

These specifications are intended to cover the supply of all material and labor required for a complete electrical installation in the new building as set forth in the title page. This involves:

A. Lighting System, 110-220 volts, D.C. or A.C.
- (1) Service, pipe, box, etc.
- (2) Main risers, private and public.
- (3) Complete distribution, basement, ground and second floors.

B. D.C. Power System, 110-220 volts.
- (1) Service, pipe, box, etc.
- (2) Main riser.
- (3) Elevator feeders.

C. A.C. Power System, 550 volts, 3 phase, 25 cycle.
- (1) Service, pipe and box.
- (2) Main riser.



Ground floor wiring plan of large office and warehouse building.

Working Conditions

1. Building is now in course of erection and nearing completion.

2. Building will be practically empty and clear for the work under these specifications, but work will have to be started at once, while some of the building trades are not yet finished.

3. Building is of semi-mill type construction with brick walls, wooden beams, columns and flooring.

Plans

Plans Nos. C-24, C-25 and C-26 are the plans for basement, ground floor and second floor respectively. These plans shall be considered as forming an integral part of these specifications.

DETAIL SPECIFICATIONS

A. Lighting System

(1) Service Pipe, etc.

1. Install standard service pipe, consisting of 3 No. 00 wires in 2-in. conduit, in rear of building as shown on plan.
2. Terminate pipe in a steel box, 12 in. x 48 in. x 12 in. deep.
3. Install in box one 200 ampere, 250 volt, 3 pole single throw switch, leaving room at top for power company's main fuse blocks. Install also at bottom two 3 pole, 250 volt fuse blocks, 60-100 amp. capacity with 75 ampere fuses. These to feed the two mains described later. Install all connections from main switch to these feeder fuses, leaving a proper meter loop and space for meter.

(2) Main Risers.

1. Install feeder of 3 No. 4 wires in 1½-in. conduit from service box to panel boxes PB1 and PB2 on side of vault in basement. This feeder is to supply the proprietor's portion of the premises (basement and ground floor) and is to be connected to one set of fuses above referred to, this set alone being fed through meter.
2. From other set of fuses, connected back of meter, install feeder of 3 No. 2 wires in 2-in. conduit to a 9-in. x 12-in. x 6-in. steel box on side of vault on third floor and install in this box one 3 pole 30-60 amp. fuse block with 50 amp. fuses.
3. From this feeder make tap on second floor of same size to panel PB 3 on front of vault on second floor. Install 24 x 36 meter board at PB3.
4. Continue from fuses in box on third floor with 3 No. 6 wires in 1¼-in. conduit to top (sixth floor) inserting a 9-in. x 12-in. x 6-in. steel outlet box on fourth, fifth and sixth floors. These boxes to be located approximately 5 feet from floor.

(3) Distribution.

1. Wiring for lighting, distribution to be installed in basement, ground floor and second floor.
2. Sub-circuits to be taken from panel boards, one for each floor as follows:

PB1: Supplying basement, located basement 3 to 2 wire type, 12 circuit capacity with knife switches and N.E.C. enclosed fuses in branches. Main switch and and fuses at base.

PB2: Supplying ground floor, located basement, 3 to 2 wire type, 10 circuit capacity, N.E.C. enclosed fuses but no switches in branches, Main switch and fuses at base.

PB3: Supplying second floor, located second floor. Metering panel of 3 to 2 wire type, 10 circuit capacity and 6 meter loops. Metering device to be of a substantial nature and not dependent on the use of clips on the bus-bars. Branches to be equipped with knife switches and N. E. C. enclosed fuses. Main switch and fuses at base.

All panels to have slate frames and to be mounted in steel boxes of surface type. Boxes to be of sufficient size to leave at least 3-inch ditching on all sides. Panels and panel boxes must be of the best quality and of a make appoved by the Engineers. Provide necessary means for metering.

3. From the above panels sub circuits to be installed as indicated on the plans and listed in the following summary. In these tables all items are to be con-

TABLE I.—LIGHTING CIRCUITS

Circ. No.	Description	No. Wires	Size Wires	Size Cond.	Approx. ft. run	No. Outl.	Total Watts	Side Panel
PB1—11 circuits:								
1	Main	2	14	½	73	6	560	R
2	Main	2	14	½	67	6	600	R
3 & 4	Main to J.B.	4	14	¾	38			
	Tap No. 3	2	14	½	32	4	400	R
	Tap No. 4	2	14	½	70	4	400	R
5 & 6	Rear Stairs, Main to J.B.	4	14	¾	84			
	J.B. to S.S.	7	14	1	12			R
	S.S. to Outlet No. 2	2	14	½	9	1		R
	S.S. to Outlet No. 3	2	14	½	14	1		
	S.S. to Boiler R	2	14	½	38	2		
	J.B. to Outlet No. 1	4	14	¾	5	1	660	
	Outlet No. 1 to S.	2	14	½	10			
	J.B. to J.B.	4	14	¾	12			
	J.B. to outlet No. 4	2	14	½	4	1		
	J.B. to top	2	14	½	65	5		
7	Main	2	14	½	91	6	600	L
8 & 9	Main to J.B.	4	14	¾	62			
	Tap No. 8	2	14	½	45	6	600	L
	Tap No. 9	2	14	½	73	7	700	L
10 & 11	Front Halls—Main to J.B. 1	4	14	¾	80			
	J.B. 1 to J.B. 2	5	14	1	13			L
	J.B. 1 to sw.	2	14	½	9			
	J.B. 2 to sub-base	2	14	½	18	1		L
	J.B. 2 to 2nd fl.	4	14	¾	22	2		
	2nd Fl. to top fl.	2	14	½	72	5	660	
	J.B. 2 to gr. fl.	2	14	½	35	1		
	Extra Tap 2nd Fl.	2	14	½	15	1		
	Ele. ta. 3rd fl.	2	14	½	10	1		
PB2—9 circuits:								
12 & 13	Main to J.B.	4	14	¾	43			

Circ. No.	Description	No. Wires	Size Wires	Size Cond.	Approx. ft. run	No. Outl.	Total Watts	Side Panel
12	Main to 1st outlet	2	14	½	32	1		
	1st to 2nd outlet	3	14	¾	10	1	360	R
	2nd out. to sw. R.	3	14	¾	16	1		
	2nd out. to 3rd out.	2	14	½	10	1		
13	Main to 1st outlet	2	14	½	7	1		
	1st outlet to 2nd out.	3	14	¾	11	1		
	tap to sw.	2	14	½	13		400	F
	2nd out. to 3rd out.	2	14	½	11	1		
	3rd out. to 4th out.	3	14	¾	11	1		
	Tap to sw.	2	14	½	15			
14	Main to 1st out.	2	14	½	42	1		
	Tap to sw.	2	14	½	15		320	R
	1st to 2nd out.	2	14	½	16	1		
	2nd out. to 3rd	3	14	¾	12	1		
	Tap to Sw. and R.	3	14	¾	14	1		
15	Main to 1st out.	2	14	½	26	1		
	1st to 2nd out.	3	14	¾	6	1		
	tap to Sws.	4	14	¾	12		420	R
	Sws. to 3rd and 4th out.	2	14	½	27	2		
	4th to 5th out.	3	14	¾	12	1		
	Tap to Sw. and R.	3	14	¾	14	1		
16	Main to 2nd out.	2	14	½	40	2		
	2nd to 3rd out.	3	14	¾	12	1	320	R
	Tap to Sw. and R.	3	14	¾	14	1		
17	Main to sw.	2	14	½	30			
	sw. to ceiling	3	14	¾	8			
	tap to vault	2	14	½	14	2		
	tap sw. to Br.	2	14	½	20	1		
	ceiling to 3rd out.	2	14	½	45	3	540	L
	3rd out. to 4th out.	3	14	¾	12	3		
	tap to Sw. and R.	3	14	¾	14	1		
18	Main to sw.	2	14	½	56			
	Sw. to 1st out.	3	14	¾	13	1		
	1st to 2nd out.	2	14	½	13	1		
	tap to Sw. and R.	3	14	¾	14	1	480	L
	2nd to 3rd out.	2	14	½	11	1		
	3rd to 4th out.	3	14	¾	11	1		
	Tap to Sw. and R.	3	14	¾	14	1		
19 & 20	Main to J.B.	4	14	¾	63			
19	Main to 1st out.	2	14	½	5	1		
	1st to 2nd out.	3	14	¾	12	1		
	tap to sw.	2	14	½	14			
	2nd out. to 3rd out.	2	14	½	11	1	460	L
	3rd to 4th out.	3	14	¾	11	1		
	Tap to Sw. and R.	3	14	¾	14	1		
20	Main to B.B.R.	2	14	½	22	1		
	Tap to Sw.	2	14	½	9			
	B.B.R. to out.	2	14	½	22	1		
	B.B.R. to sw. box	2	14	½	26		630	L
	Sw. box to out.	2	14	½	18	1		
	Sw. box to B.B.R.	7	14	1	19	1		
	Tap to B.B.R. Sw. and out.	2	14	½	25	2		
	B.B.R. to sw. box	6	14	1	10			
	Sw. box to out.	2	14	½	18	1		
PB3—10 circuits:								
21 & 22	Main to J.B.	4	14	¾	44			
	Tap No. 21	2	14	½	36	3	300	R
	Tap No. 22	2	14	½	36	4	400	R
23	Main	2	14	½	71	4	400	R
24	Main	2	14	½	51	4	400	R
25	Main	2	14	½	52	4	360	R
26	Main	2	14	½	63	4	400	L
27 & 28	Main to J.B.	4	14	¾	47			
	Tap No. 27	2	14	½	40	4	400	L
	Tap No. 28	2	14	½	52	4	400	L
29 & 30	Main to J.B.	4	14	¾	88			
	Tap No. 29	2	14	½	27	3	300	L
	Tap No. 30	2	14	½	39	3	300	L

sidered as strictly specified with the exception of the column marked "Approximate feet run." These quantities are given for convenience only and are not guaranteed.

B. D.C. Power System

(1) Service Pipe, etc.

1. Install standard service pipe consisting of 3 No. 0000 wires in 2½-in. conduit at rear of building, as indicated on the plans.

2. Terminate service pipe in steel box 24-in. x 48-in. x 12-in. deep.

3. Install in box one 300 ampere, 250-volt, 3-pole, single throw knife switch leaving room above for power company's main cut outs. Install also 3, 100-200 amp., 250-volt. fuse blocks with 125 amp. fuses. These are to supply main riser and be connected direct to main switch.

4. Install also one double pole, 250-volt, 30-60 amp. fuse block with 50 amp. fuses and one double pole 60-100 amp. fuse block with 75 amp. fuses. These are to

supply freight and passenger elevators respectively and be connected up to main switch leaving proper meter loop and space for meter.

(2) Main Riser.

Install feeder from the above service box to side of vault and up to top floor. Same to consist of 3 No. 0 wires in 2-in. conduit. Steel boxes 9-in. x 12-in. to be inserted in riser on 3rd, 4th and 5th and 6th Floors.

(3) Elevator Feeders.

1. Install feeder for passenger elevator from 75 amp. fuses in service box to sub-basement under front entrance. Feeder to consist of 2 No. 4 wires in 1¼-in. conduit. Install at end of this feeder one 250-volt 100 amp. double pole, single throw fused knife switch in a suitable steel box. Same to be located within 10 feet of elevator motor.

2. Install feeder from 50 amp. fuses in service box to freight elevator pent house as indicated on plan. Feeder to consist of 2 No. 6 wires in 1-in. conduit. Install at end of feeder one 250 volt 60 amp. double pole single throw fused knife switch in a suitable steel box, same to be located within 10 feet of elevator motor.

C. A.C. Power System

(1) 1. Install standard service pipes at rear of building as shown on plans. Same to consist or 3 No. 6 wires in 1¼-in. conduit.

2. Terminate service pipe in a 600-volt 30-60 amp. 3-pole service switch box. D. & W. No. 1818 or equivalent. Same to be equipped with proper outlet hoods and located immediately above Lighting and D.C. Power service boxes above referred to. This box to be equipped with 50 amp. fuses.

(2) Main Riser.

From service box run feeder consisting of 3 No. 6 wires in 1¼-in. conduit to side of vault and up to top floor. Insert 12-in. x 15-in. x 6-in. steel boxes on 3rd, 4th, 5th and 6th floors.

The following summary of services, risers and power-feeders is appended for additional conveniences, the figures given under "approx. feet run" not being guaranteed.

Conduit Work

1. All conduits must be secured directly to ceilings or walls, without the use of hangers.
2. All conduits must be run rectangularly, i.e., parallel with or at right angles to building lines.
3. All feeder conduits must pass directly through beams, the necessary holes being bored for the purpose. Sub-circuit conduits may be passed through beams by boring or looped under as deemed preferable. In case conduits are looped under, turns must be made by means of L condulets.

Wires

1. All sub-circuit wires to be No. 14 B. & S. gauge. Feeder wires to be of sizes indicated in the foregoing.
2. All wires of No. 6 gauge or over to be stranded.
3. All wires to be New Code standard.

Fittings

1. Outlet Boxes. All ceiling outlet boxes to be 4-in. x 2¼-in. round or octagonal Bossert or equivalent.
2. Wall Receptacles. All wall receptacles to consist of Type G or Type H condulets with porcelain receptacles, with the exception of private offices where flush type receptacles are to be used wherever conduit can be concealed in partition.
3. Switch Outlets and Switches. Switches to be of the rotary snap type of approved make and mounted on Type G or Type H condulets. In private offices wherever conduit can be concealed in partition push button switches are to be used. This applies particularly to 3-way switches in front corner office, and switches in main entrance hall. Wherever a switch outlet and wall receptacle occur together, a Type G and a Type H condulet shall be mounted in tandem, the receptacle being immediately below the switch.
4. Condulets, etc. All taps to switches or wall receptacles must be made with T condulets, boxes not being permitted. Dividing points of two circuits run in a common conduit and marked J.B. on the plans, may be made with T condulets or Junction boxes, as preferred. In the latter case box must be the same as standard outlet box employed.

General Conditions

1. The "General Conditions" attached herewith shall be considered as forming an integral part of these specifications.
2. All materials and workmanship shall conform to the requirements of The Canadian Fire Underwriters' Association and their certificate furnished at the completion of the work.

General Conditions

1. These General Conditions shall be considered as forming an integral part of any specifications to which they may be attached and shall be absolutely binding in carrying out any contract awarded in accordance with such specifications.
2. The following interpretations shall be taken of terms used throughout the specifications.

The Proprietor means the party or parties who own the building or properties in which the contract is to be fulfilled.

The Contractor means the party or parties to whom any contract may be let on the basis of these specifications.

The Architect means the architect or firm of architects

TABLE II.—SERVICES AND RISERS

System	Description	No. Wires	Size Wires	Size Cond.	Approx. ft. run	
Light	Stand pipe	3	00	2	20	
	Private Main	3	4	1½	66	Ending at PB1 and PB2.
	Public Main to 3rd Fl.	3	2	2	91	To 9 x 12 box on 3rd Fl. with 3-30-60-amp. fus. block and 50-amp. fus.
	Tap to PB3	3	2	2	14	
	3rd Fl. to top	3	6	1¼	29	9 x 12 boxes on 4th, 5th and 6th floors.
D.C. Power	Stand Pipe	3	0000	2½	20	
	Main and Riser	3	0	2	120	9 x 12 boxes on 3rd, 4th, 5th and 6th floors.
D.C. Feeders	To Pass. Ele.	2	4	1¼	140	To 250 v. 100 amp., 2 PST fused sw. in iron box.
	Freight Ele.	2	6	1	80	To 250 v. 60 amp. 2 PST fused sw. in iron box.
A.C. Power	Main and Riser	3	6	1¼	120	12 x 15 boxes on 3rd, 4th, 5th and 6th floors.

under whose charge the building work is being carried on and who is exercising supervision over any or all trades which may be doing their work at the same time as the work called for under these specifications.

The Engineers mean the engineers who have drawn up these specifications and under whose supervision any contract awarded on the basis of such specifications must be carried out.

3. The Contractor (unless otherwise specified) shall provide all materials, workmanship, plant, scaffolding, carriage, freightage and every other matter that may be required for the proper performance and completion of the work and the whole of which are to be the best of their several kinds.
4. The plans accompanying these specifications shall be considered an integral part of the same. Specifications and accompanying plans are intended to cooperate, so that any work shown on the plans and not mentioned in these specifications, or vice versa, is to be executed the same as if set forth by the plans and mentioned in these specifications.
5. Should any drawings or figures be omitted in the plans and details which are necessary to a clear comprehensive understanding, or should any error appear in either plans or specifications, it shall be the duty of the Contractor to notify the Engineers in writing of such omission or error before submitting tender, and in no case proceed in uncertainty with the work.
6. If in the opinion of the Contractor a change of plans or specifications should be made for the proper completion of the work, and if such change alters in any way the original amount of the tender, the Contractor must notify the Engineers and submit price in writing for approval before starting the work. Otherwise, the Engineers will not recognize any change in plans or specifications and no claim for extra payment will be allowed.
7. The plans accompanying these specifications are made as accurate as possible, but absolute accuracy of dimensions cannot be guaranteed. No claim for extra payment on account of difference of actual and estimated dimensions shall be allowed, unless such difference arises through alteration of building plans by the Architect, or unless such difference shall be greater in amount than ten per centum in each case. On all plans figured dimensions are to be taken in preference to measurement by scale and drawings on a large scale are to be taken in preference to those on a small scale.
8. On all plans the correct size, location and nature of all walls, partitions or obstructions of any kind are indicated as accurately as possible. If any additional obstacles are encountered, the Contractor must make good all work through or around such obstacles the same as if they had been originally indicated, and no extra claim shall be allowed on account of such obstacles.
9. The Contractor shall at his own cost make good any defects, settlements, shrinkages, burnouts, grounds or other faults in his work, arising from defective or improper materials, which may appear within twelve months after the completion of the contract.
10. The Engineers reserve the right to reject any and all materials which, in their opinion, are unsuitable for the proper completion of the work, or not in accordance with these specifications, or accompanying plans. Such rejected materials must be removed from the premises forthwith and if used after such rejection the Contractor shall at his own cost tear down such materials and replace same with approved materials.
11. Successful Contractor shall be required to sign the specifications and accompanying plans as well as revised contract form in which shall be stated manner of payment, time limit, amount of tender, etc.
12. The Proprietor reserves the right to accept or reject any or all bids presented in determining to whom said contract will be awarded. The tenderer's reputation, as well as the amount of his proposal, will be considered and the contract made in accordance therewith.
13. The Contractor will notify the Engineers in writing when his contract is complete. This dated letter will be necessary to obtain his final certificate, which will be issued within thirty days after notification, if the Engineers, on inspecting the work, consider the same complete.

Tallman Brass & Metal Company

The Tallman Brass & Metal Company, who commenced manufacturing electrical fixtures in Hamilton less than a year ago have evidently met with excellent success as they announce that they will shortly add a large addition to their factory, amounting to some 22,000 square feet of floor space. This company has had a lengthy experience in the brass business and under a competent organization they have been able to give their customers fixtures both in original designs and of a superior quality and finish. In addition, a very thorough inspection system has been established both during manufacture and in connection with the shipping department, so that customers may be assured of satisfaction in their shipments. Indeed, the fact that this company find it necessary to work overtime during a dull season and to extend their floor space, speaks well for the quality of the goods and service being turned out. Canadian customers are apparently appreciating the fact that work of this sort is being turned out in a Canadian factory, where in addition to the most skilled workmen, a number of designers are employed who will submit special drawings, on application, to meet the particular wishes of the individual purchaser. The Tallman Company are now distributing a very handsome fixture catalogue.

Safety First

The following double acrostic written by Mr. R. W. Ennis, Assistant Master Mechanic of the Toronto & York Radial Railway, suggests an entertaining method of giving more publicity, by poster or dodger, to this important movement.

SAFETY FIRST

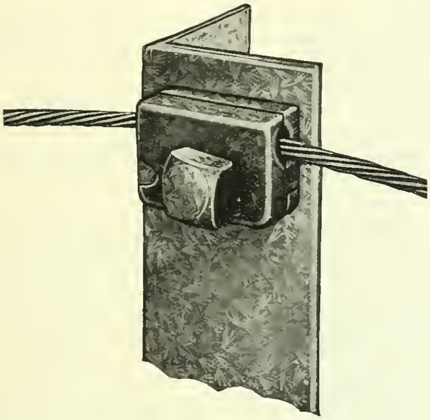
S afety first, last and alway S
A m I my brother's keeper? Yes, and it is A
F irst duty to protect him, my employer and mysel F
E ver being on the alert, watching for troubl E
T o eliminate carelessless in any capacity and assis T
Y oung and old to reach their goal in safet Y

F irst stop, look and listen, be sure yoursel F
I lluminate and guard dark spots and places
show and be shown, be from Missour I
R emember, accidents are sometimes the result
of carelessness, so conside R
S tudy the relations of rules and regulation S
T o the ever present and worthy subjec T
SAFETY FIRST

The Canada Wire & Cable Company, Limited, are increasing their capital from $500,000 to $3,000,000.

Ground Wire Clamps

A new ground wire clamp, greatly improved in design, has been placed on the market by the Electric Service Supplies Company. It consists of two identical malleable iron castings, which when fitted together form a clamping jaw to receive either 1/4 or 5-16-inch strand. A 5/8-inch bolt of any practical length is placed through these castings so allowing this clamp to be rigidly secured to either bayonets or other ground wire supports used in high tension transmission line construction. These clamps may also be secured directly to wooden or iron poles by means of a through bolt when angle iron supports are not used. A worthy feature of this clamp is that they require but one bolt and are so designed that they may first be secured to the bayonet or pole and the ground wire to be supported placed therein afterwards. Greater wear is insured that part



New type of clamp.

of the ground wire inside the clamp on account of the corrugated surface and the flares at either end of the hole. It will be seen that greater protection is given the strand due to the actual clamping surface being but 3/4-inch, the full width of the clamp being 2 1/4 inches, therefore allowing a flare at each end of 3/4-inch. Type B clamps differ from the standard type formerly described in that the clamping surface is not corrugated; the whole clamping surface being smooth but with flaring ends. These ground wire clamps are furnished complete with bolts, nuts and lock washers. All parts are heavily galvanized to effectually withstand the action of rust.

An Interesting Exhibit.

The Canadian Laco-Phillips Company had an interesting exhibit of nitrogen-filled lamps in rooms 310-11 Ritz Carlton during the C. E. A. Convention. Sizes from 250 watts to 1,000 watts were shown. In this later type of Laco lamps the design has been improved by the insertion of a sheet of mica in the upper portion of the lamp which is claimed to maintain the leading-in wires at a considerably lower temperature.

New Companies

The Excelsior Electric Manufacturing Company, Limited, has been incorporated with capital $40,000, and head office, Toronto.

The Canadian Hart Accumulator Company, Limited, has been incorporated with capital £60,000, and head office St. Johns, Que.

Personal

Mr. R. A. Sara sales manager of the Winnipeg Light and Power Department received the degree of Electrical Engineer at the recent University of Toronto Convocation.

Mr. C. L. Howse, formerly of the Hamilton Hydro-electric Department has been appointed manager of the hydro-electric and waterworks system of Peterboro, Ont.

Mr. S. L. B. Lines, general manager the Chamberlain and Hookham Meter Company of Canada, was married on June 27 to Miss Ethel Moore Lamping, of Ridley Park, Pennsylvania.

Mr. J. J. Ashworth, assistant general manager of the Canadian General Electric Company was married on June 16, to Miss Alyce Cooke, of Montreal. Included among the wedding gifts was a cabinet of silver from the president and directors of the company and a silver tea service from the district managers.

Trade Publications

Electric Hoist—Bulletin 301A issued by Pawling & Harnischfeger Company, Milwaukee, describing and illustrating the application of the electric hoist.

Lamp Guards—Folder issued by the Electric Service Supplies Company illustrating and describing the Keystone lamp guards, portable and stationary types.

Truss Pins—Catalogue issued by the Electric Service Supplies Company illustrating and describing Keystone truss pins and other transmission specialties.

Steel Taped Cable—Catalogue issued by The Simplex Wire & Cable Company, illustrating and describing at considerable length, the Simplex Steel Taped Cable.

Travelling Cranes—Bulletin issued by the Herbert Morris Crane & Hoist Company, Limited, describing and illustrating the Morris hand overhead travelling crane, type G.

Bell Ringing Transformers—Small folder issued by Canadian General Electric is describing Wayne bell ring transformers for which this company are Canadian agents.

Panels—Bulletins No. 34 and 35 issued by the Canadian Krantz Electric & Manufacturing Company describing and illustrating respectively the Krantz safety panel and the Krantz straight line panel.

Travelling Cranes—Folder issued by the Canadian General Electric Company describing a Sprague travelling crane employed in the shops of the Ford Motor Company, Detroit, for carrying heavy loads.

Wheeler Reflectors—Supplement issued by the Canadian General Electric Company describing, with illustrations, Wheeler angle reflectors for lighting tennis courts, ball grounds, bathing beaches and other outdoor recreation grounds.

Transformers—Bulletin 105 issued by the Wagner Electric Manufacturing Company, St. Louis, illustrating and describing central station transformers. Some interesting information is given regarding the theoretical construction of this apparatus.

Railway Signals—The General Railway Signal Company are distributing additions to their catalogue Section A, Part 6, on Table and Wall Lever Stands; also addition to catalogue Section B, Part 3, on Mechanically Operated Train Order Signals.

Wiring Devices—Catalogue 22 issued by Pass & Seymour, Inc., describing their handy electrical wiring devices. A special feature of this catalogue, in addition to very profuse illustrations, is a reproduction of some 25 different color finishes. This will be found of great assistance by the prospective purchaser.

Current News and Notes

Belcarres, Sask.

Mr. J. Dawsey, of Melville, is erecting an up-to-date hotel at this place and is installing an electric light plant to light this hotel and a portion of the town. A telephone will be installed in every room.

Calgary, Alta.

Commissioner Graves estimates that the Municipal Electric Railway System will have a considerable deficit during the present year which may amount to as much as $50,000. General trade depression in Calgary, in addition to a large increase in interest charges as the result of heavy extension work carried out the last year, are given as the main causes. It is understood, too, that Calgary pays about the highest, if not the highest, wages of any Canadian city.

Chilliwack, B.C.

Contract has been closed with the British Columbia Electric Railway Company for ten years, under which they supply the town of Chilliwack with 100 watt tungsten lamps installed on brackets. These are for street lighting purposes and replace the old 32-candle power carbon lamps.

Camrose, Alta.

The town of Camrose has placed an order with the Hill Tripp Pump Company for a six-inch centrifugal deep well pump to be driven by a 20 h.p. motor direct connected. This pump will be working at 105 feet from the ground level and will replace an air lift pump which has been in operation for the past four years.

Calgary, Alta.

A by-law was recently passed authorizing the expenditure of $300,000 on electric light extensions.

Dartmouth, N.S.

Tenders are received to July 2 by the Department of Railways and Canals for a branch telegraph line in the neighborhood of Dartmouth.

Edmonton, Alta.

The 178 white way lights which the city is now installing will be ready for operation by the first of August, 1914.

The Alberta Government will soon proceed with the erection of a modern long distance telephone exchange in the southeast part of the city.

The Dominion Government having voted the necessary money to build a telegraph line from Lake Saskatoon, Alberta, to Fort St. John, B.C. A gang of men will soon be on its way to construct this line, with Mr. G. Wilder at the head of it. The work will occupy about five months.

The Wabamun Power and Coal Company of this city are preparing plans and estimates for the construction of a power plant to be located at their mine forty miles west of Edmonton. They now have two of their engineers visiting Pacific Coast cities to gather information. The original capacity will be 10,000 kw. and will furnish power to the city and to towns and villages within a radius of 100 miles of Edmonton.

Reports so far go to show that the increase in the Edmonton Street Railway fare to a straight 5c fare is increasing receipts without causing any noticeable falling off in traffic

Hamilton, Ont.

Invitations have been sent out for a celebration on July 1st. in connection with the turning on of the new street lighting system.

London, Ont.

The London Street Railway Company are making a new bond issue to the extent of a quarter of a million dollars.

Lacombe, Alta.

The town of Lacombe is in the market for a small turbine of 60 kw. capacity to connect to one of their spare generators.

Lethbridge, Alta.

By-laws will be submitted on July 3 authorizing the expenditure of some half million dollars for various kinds of municipal work. About $25,000 will be used on extensions to the railway system.

Moncton, N.B.

A special committee has been appointed, including City Engineer Edington and City Electrician Cochrane, to consider the matter of installing a better street lighting system. It has not yet been decided what type of lamp or standard will be used, but it is probable, judging by present indications, that a municipal generating plant will be established.

Montreal, Que.

The plans and specifications of conduits on Craig, McGill, Notre Dame and St. James Streets, Montreal, have been approved by the Quebec Public Utilities Commission, and tenders for the work have been called for July 10.

Many of the proprietors and tenants on St. Catherine Street, Montreal, have failed to comply with the order of the Electric Service Commission to connect with the underground conduits, thus delaying the removals of the poles. The Board of Control have given instructions to the attorney to compel compliance with the order.

The Eugene F. Phillips Electric Works, Limited, Montreal, have received the following orders:—for the City of Westmount, twenty miles of single, twin, and three conductor paper insulated, lead covered cable, and four miles of twin and six conductor paper insulated, lead covered cable; for the Montreal Light, Heat and Power Company, fifteen miles of paper insulated, lead covered cable, to be used on the St. Catherine Street conduit; for the Ontario Hydro-electric Power Commission (Windsor), five miles of paper insulated, lead covered, double steel tape armoured cable; for Yorkton, Sask., a similar order; for the city of Calgary, one mile of paper insulated, lead covered cable.

Outremont, Que.

A contract has been awarded to the Northern Electric Company for 20,000 feet of cable.

Owen Sound, Ont.

Contracts have been awarded for the construction of two dams in connection with the hydro-electric developments at present under way at Eugenia Falls by the Hydro electric Power Commission of Ontario.

Regina, Sask.

The operation returns of the municipal street railway,

Regina, for the week ending June 13th are as follows: Revenue, \$3,695.30; passengers carried 86,258; passengers carried including transfers 98,149. For work ending June 20 corresponding figures are.—\$3,986.90, 94,945 and 107,749.

The Hope Telephone Company, Limited, Abernethy, Sask., has been incorporated with capital \$900.

South Welwyn Telephone Company, Limited, has been incorporated with head office Welwyn, Sask., and capital \$1,500.

Sherbrooke, Que.

The Gas and Electric Department have been authorized to engage a consulting engineer to act jointly with the City Engineer, Mr. Tremblay, in the construction of a concrete dam at the city's municipal electric plant on the Magog River.

The Gas and Electric Department have made a request to Council for a meter appropriation of \$16,000 for the purchase of two thousand electric meters.

The Sherbrooke City Council have decided on a conduit and street lighting system for the main streets, and estimates of the cost of the former are being made by the electric committee. For experimental purposes, the committee will purchase six or twelve standards for the street lighting. An appropriation of \$16,000 has been made for 2,000 electric meters. A consulting engineer will be engaged to prepare plans and specifications, in conjunction with the city engineer, for the construction of an additional dam at the city's electric plant on the Magog River.

Saskatoon, Sask.

The increase in the Provincial telephone and telegraph lines in the last ten years is from 1,569 miles in 1903 to 16,585 miles in 1913.

The financial report for the first three months of 1914 as presented to council at the recent meeting, shows that the Public Utilities, with the exception of the street railway sysem, are making fair profits. During this same period the street railway deficit amounts to over \$14,000, which more than offsets the profits of the light and power departments. At the present time, however, conditions are improving, and the month of June is expected to show a loss not greater than \$1,000.

Sudbury, Ont.

Grading started on May 30th on the route of the Sudbury-Copper Cliff Suburban Electric Railway Company which runs parallel with the Copper Cliff Road. Two miles of grading are completed to date. The total length of this Copper Cliff road is 5.1 miles. Further proposed extensions include the Ramsay Lake road, 1.2 miles, and the Frood Mine road of 2 miles, making a total of 8.3 miles. The Warren Bitulithic Company will put in the concrete bed and paving for the railway and the company will lay their own track. It is not yet definitely determined which motive power will be used but gas-electric is contemplated. Mr. C. D. Norton, Sudbury, is engineer in charge of this work.

St. John, N.B.

The St. John Railway Company have received two new steel cars from the Ottawa Car Company.

St. Catharines

Mr. J. S. Campbell, Chairman of the St. Catharines Civic Hydro-electric Commission recently presented to Council an estimate on an ornamental street lighting system covering a number of streets in St. Catharines. Mr. Campbell's report was in part as follows:

"In accordance with the wish of the members of the council attending the joint meeting of the Committee on Works, the Fire and Light Committee, and this Commission, held on the evening of June 11th, we beg to submit to you an estimate of an ornamental underground lighting system, covering the streets mentioned in the statement published on the 27th of May last.

"The estimated cost of 105 single light standards with 1,000 candle-power lamps spaced on St. Paul street, Queen and James streets, approximately as shown on attached print, is \$11,304.

"The estimated cost of operating these lights is \$4,915 per year, or an annual cost per standard of \$46.81. Deducting from this cost the annual cost of the ordinary street lighting system, the net annual cost per standard, which we understand you desire to charge against the property on the frontage basis as a local improvement, is \$42.80 per year. These lamps, being spaced approximately 100 feet apart on both sides of the street and staggered so as to put one light every 50 feet of the length of each street, would give an approximate cost per foot frontage of 43c per year.

"The estimated cost of 61 single light standards with 100 watt lamps spaced on Church and Ontario streets, approximately as shown on attached print, is \$6,093.

"The estimated cost of operating these standards is \$1,393, or an annual cost per standard of \$22.84. Deducting from these costs the cost of the ordinary street lighting, the total annual cost is reduced to \$926.40. The net cost per standard to be borne by the owners of the frontage on the local improvement basis would be \$15.19 per standard per year. These lamps being spaced approximately 200 feet apart on both sides of these streets and staggered so as to place one light every 100 feet the length of the street, would give an approximate cost per foot frontage of 7.6c per year.

"On Ontario street, from St. Paul to King street, there has been some question as to the type of standard to be chosen; whether the high candle-power used in the business districts or the residential type, the latter possibly spaced at half the distance of the spacing in the residential districts. With the cost per standard given above your decision can be made and the resultant cost readily determined."

Toronto, Ont.

Works Commissioner Harris has prepared a report dealing with the probable revenue on the Municipal Electric Railway System by an interchange of traffic with the Toronto Street Railway Company. The proposal was for an interchange fare of 5c, and the report finds only a municipal saving of \$6,000.

The matter of rate reduction which the local commission asked the city council to pass upon has been handed back to the commission with power to do as they think best.

The city council have passed a by-law authorizing the official notification of the Toronto & York Radial Railway Company that the city will take over that portion of the line between the C. P. R. tracks and Farnham Avenue at the expiration of the franchise, next year.

Westville, N.S.

The city is negotiating with the New Glasgow Electric Company, through Mr. Flaherty, for a flat rate contract. The company offers a rate of \$11 per lamp per annum. This service has been on meter up to the present time.

Winnipeg, Man.

The Winnipeg Omnibus Company has been granted a five-year franchise for the operation of motor busses on the streets of Winnipeg, and have deposited a cheque for \$5,000 as a guarantee of good faith. If satisfactory agreements can be reached with the city council, it is promised that operations will be started immediately.

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Generation, Transmission and Application of Electricity

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Purifying Water by Electricity

The most recent developments in the purification of water indicate that the central stations will reap considerable benefit. Filtration apparently has its disadvantages, one of which is that it is exceedingly expensive both to install and maintain. The use of chloride of lime which has been practised very extensively in Toronto and has given most excellent results, is objectionable from the fact that few people care for the flavor it imparts to the water. The method of purification which is evidently increasing in popularity is sterilization by electricity in one form or another. The ozonizing process which has been used with considerable success at certain places on the European Continent, has now given way to the ultra violet method of purification. By those who have made a most careful study of the subject of purifying water this method is considered as certain to become very generally adopted in the next few years.

Briefly described, the sterilizing apparatus consists of a mercury vapor lamp enclosed in a quartz jacket, placed in actual contact with the water to be purified. In certain cases, the water is allowed to circulate around the lamp in such a way that it is pierced by the rays for a longer period. Where efficiency is not a very important factor, good results can be obtained by placing the lamp above the water and as close to it as possible. By the use of these lamps it is found that water bacteria are killed in a small fraction of a second. There is one essential in connection with this system of purifying, namely, the water must be perfectly clear, so that the rays will pass through without obstruction. It follows that the filtration system operating in series with a mercury vapor sterilizing system is an ideal arrangement.

From the central station point of view, the advantage will not be the size of the load so much as its satisfactory nature. It is stated that from 50 to 130 kw.h. represents ample energy to purify 1,000,000 gallons. As this would represent the demands of a population of approximately 10,000 people, it can readily be determined what the load would be in villages, towns or cities of various sizes throughout the Dominion. For example, in Toronto, where the daily consumption is in the neighborhood of 60,000,000 gallons, the number of kw.h. of energy required for the purification of this amount would be 60 times 130 at the maximum, or 7,800 kw.h. This amount spread over the 24 hours would mean a steady load of something over 300 kw. It is, however, to be noted that this represents a load which would, practically speaking, not vary at all day or night, winter or summer.

The low current consumption, as shown in the last paragraph, is one of the important advantages to a municipality in this system of purification. Suppose municipalities were able to get a one cent rate for this amount of power load, the cost of sterilizing all the water used in the city of Toronto would be only $78 a day. At the present time the big item of expenditure is the lamps. These are expensive to purchase and have a comparatively short life. There appears to be little doubt, however, that with developments in lamp manufacture the ultra violet method of water purification is destined to become very much more general in towns and cities of all sizes within the next few years.

Ground Your Transformers

Central Station managements would do well to take to heart the recent Quebec decision which resulted adversely to an operating company because they did not have their distribution secondaries grounded, as advised by the National Code.

So far as we know, the law of Quebec does not make it necessary to ground transformer secondaries and the ruling is all the more significant in that it indicates that what is considered good practice by engineers and associations of good standing is as likely to regulate the ruling of a court of justice as a law actually placed upon the statute books.

In the particular case referred to, fire occurred as the result of a tree falling across the primary wires and bringing them into contact with the secondary wires which entered the building. The building was burned down and the insurance paid. Action was instituted however by the insurance company to recover from the electric company, their claim being based upon the argument that if the secondaries had been grounded, as good practice demands, fire would not have occurred. It was shown by defendants that the tree which caused the accident belonged to the owner of the building burned and it was claimed that the electric company could not be held responsible. The decision favored the insurance company at every point, however, and judgment was given for the full amount of the policy payment.

We understand there are still a considerable number of systems operating in Canada ungrounded. It is possible these may continue to operate for many years without accident, but in consideration of the facts that have been brought out in the last few years and the unanimous opinion of operating and consulting engineers in favor of grounding, it would appear to be nothing more than good insurance to take immediate steps to prevent accidents such as the above, to say nothing of many similar accidents often resulting fatally to operators and others that have occurred during the past two or three years. Doubtless the legislatures of the various provinces will soon make the change obligatory, but, in the mean time, it is evident that the absence of such a law does not relieve the operating company of responsibility. Quite aside from the humanitarian viewpoint the expenditure incurred in properly grounding every secondary system is likely to prove a good investment.

The Electric Auto is Coming

The electric automobile appears to be winning its way rapidly not only as a town convenience but as a touring car. The Electric Vehicle Association of America is a live organization which has done much to popularize the use of the electric vehicle in the United States by systematic tests on the possibilities of the electric, and judicious advertising of the results.

Quite recently a paper was read before this association on the subject of "Touring By Electric Automobiles," and the data contained indicates that the day is not far distant when we shall not hesitate to venture outside the city limits with a storage battery car. One of the tours described in this paper started at Boston on October 14 and reached Chicago on October 31 having travelled a distance of 1,305 miles. The highest daily run was 173.5 miles between Syracuse and Buffalo. Apparently no great difficulties were experienced and excellent time was made. The paper also gives a list of runs, made on one charge of a battery, which vary in length from 103.2 miles at an average speed of 20.14 miles per hour to 27.3 miles at an average speed of 26 miles per hour. Another interesting report just to hand tells of an electric 1,000 lb. delivery wagon which made a trip from Buffalo to Lockport and back, 52 miles in all, and carried a 900-lb. load on the return trip, in the total time of 3½ hours. The current consumed on the round trip was only 105 ampere hours which at Buffalo's regular rate amounted to less than 10c. On another occasion the same car made a 70-mile trip on 130 ampere hours. The car in this trip travelled at high speed, as far as possible, all the way.

A very interesting item in the service report of the city of Memphis Police System states that the number of miles operated during 1913 was 18,529 and that the cost of battery maintenance during this time was nothing except the cost of battery solution, which amounted to $11.92.

With such figures as these to reassure us we need not hesitate to be enthusiastic about the future of the storage battery car, not only for general delivery and city passenger traffic but for suburban work as well. The difficulty of course, lies, at the present time, in the considerable distance between charging stations. With perfection and simplification of charging apparatus, however, this will be remedied. Improvements may also confidently be looked for in battery capacity and life.

A Fair Interest Return

In an address delivered recently before a public meeting in Toledo, where there has been considerable difficulty over the electric railway situation, Mr. Thos. N. McCarter, president of the Public Service Corporation of Newark, N.J., which practically controls the electric railway service in that state, spoke forcibly on a number of items of vital interest to the railway industry such as adequate fares, reasonable returns on capital, satisfactory relations existing between his corporation and the authorities of the state in which he operated, the proper time for a franchise to run, etc. Mr. McCarter as the president of a system which has yearly gross receipts of approximately $16,000,000 of necessity speaks with authority and his statements will be read with unusual interest. He quoted figures to show that in New Jersey a 3c fare positively is not sufficient to pay the operating charges of their system. He also discussed in a very judicial way the question of interest return which shareholders who have invested their money in electric railway enterprises may naturally expect, and places this at 8 per cent. He points out that the hazards of the business, the probabilities that the early years will yield no interest returns at all and the difficulties of obtaining capital make this rate an absolute necessity. Another matter discussed by the speaker was the franchise question and it is interesting to note that Mr. McCarter's opinion is that a short term franchise is very unsatisfactory from the standpoint of the municipality. We print an extract from the address on other pages of this issue.

Japanese Electrical Progress

How greatly Japan has increased as a market for electrical goods may be understood from the fact that whereas in 1903 the capital invested in electrical supply undertakings and electric railways was £2,858,000, in 1911 it had increased to £47,163,000, and the last two years have, although statistics are not yet available, shown at least an equal rate of advance. During the same eight years the electric power for which sanction had been given rose from 44,000 kw. to 344,000 kw., the length of transmission lines from 5,981 to 33,584 miles, the length of electric railways from 93 to 704 miles, and the total power of electric motors installed from 3,000 kw. to 33,000 kw.

Native factories for the manufacture of motors, transformers, switchboards, the simpler forms of electric meters and other measuring instruments, electric lamps, electric wire, etc., have been established, but the more important classes of machinery, complicated instruments, most of the metal filament lamps, electric cable, etc., are all necessarily imported, and such oversea purchases continue steadily to increase. Thus Great Britain shipped to Japan in 1912, the last year for which returns are available, electrical machinery to the value of £242,683, against £232,690 in 1911, and £162,924 in 1910; also other electrical apparatus, including batteries, lamps, carbon rods, telegraph and telephone apparatus, and wires and cables, to £375,041, against £201,664 in 1911, and £279,328 in 1910, such figures providing fair evidence that, in spite of the growth of native factories for the manufacture of machinery and apparatus, the import trade is at a higher level than ever before, and indeed shows not the slightest sign of decline. In regard to the local manufacture of metal filament lamps, it is to be noted that the filaments have to be imported, and are made into lamps in native workshops under license. Even should the manufacture of dynamos at the Shibaura Works and of cable at the factory owned by the Yokohama Electric Wire Company prove ultimately successful—and there seems some prospect of this in the fact that at the former a dynamo of 6,000 kw. has been turned out—the market will still be a valuable one for importers, especially in regard to requirements in connection with large installations.—(British Export Gazette).

Canadian National Exhibition

The management of Canada's world-renowned National exhibition have just issued their first bulletin which describes, in part, a number of interesting features in connection with this year's show. The date set is from August 29th to September 14th. Numerous inquiries have already been received regarding space for exhibits from points never before represented, which indicates that this will be the best year our National Exhibition has ever known. Electricity will play a larger part this year than ever in its power, lighting and decorative applications. The system of electric ornamentation that has been developing during the past few years will be practically complete this year. The Grand Plaza will be canopied with electric stars. The Fountain will be illuminated and various devices symbolic of Peace Year will be utilized to further beautify the grounds. Among the entertainment attractions might be mentioned:—daily hydro-aeroplane flights, Grenadier Guards Band, Guiseppe Creatore's Band, and the International Peace Tattoo in which ten bands will take part in the celebration of 100 years of peace between Great Britain and the United States.

Grounding Secondaries

Mr. Justice Dorion, sitting in Quebec, on July 3 gave judgment in two actions against the Quebec Railway, Light, Heat and Power Company, this being the first judgment of this character since the National Electrical Code made grounding obligatory. The plaintiffs were the Guardian Assurance, Liverpool & London Assurance, Phoenix Assurance and Queen Assurance Companies, and Mr. G. A. Vandry, and the actions were to recover damages caused by fire through a branch of a tree falling during a storm and causing the primary wires of the lighting system to come into contact with the secondary wires, supplying a number of customers from a transformer which was not grounded. Two buildings were destroyed, and the insurance companies paid the sum of $18,-152. The companies sued the defendants for this amount on the ground that the transformer secondary neutral should have been grounded. The court gave judgment for the full amount with interest and costs, holding that the plea of the defendants that the tree (which belonged to one of the parties) was a known hazard and should be provided against, was insufficient. It considered that the company were responsible for the damage, in view of the fact that they had not grounded their transformers, as recommended. He also gave judgment for $7,443 with interest and costs in favor of Mr. Vandry,—a total of $25,596. Dr. Herdt and Messrs. J. Bennett, R. M. Wilson, and J. M. Robertson, of Montreal, were witnesses in the case.

Abitibi Pulp & Paper Company

The electrical work in connection with the plant of the Abitibi Pulp & Paper Company, at Iroquois Falls, Ontario, is now well advanced. This work consists of installation of conduit work, exposed work, outside line work, generator leads to large water trubine-driven generators and complete electrical distribution for light and power. The generators have a capacity of 1250 kv.a., 600 volt, 3-phase, 60-cycle. The current for the lighting is stepped down by means of transformers to 110-220, single phase.

The power distribution is of special interest, consisting of connections from switchboard to the following motors:

2—150 h.p. screen motors.
2— 85 h.p. wet machine motors.
2— 75 h.p. white water pump motors.
2—150 h.p. refinery motors.
1— 25 h.p. machine shop motor.
1— 20 h.p. elevator motor.
1— 30 h.p. save-all motor.
1—250 h.p. mill water supply pump motor.

The above motors are situated in screen room at an approximate distance of 500 feet from the power house. Feeders to this building are run from the power house over roof of grinder room and thence on poles to the screen room. These feeders are made up of six 500,000 c.m. cables.

In addition to the above, in the wood repairing room there are the following motors:

1—150 h.p. hydraulic pressure pump motor.
1—125 h.p. saw slasher motor.
1— 25 h.p. conveyor motor.
1—150 h.p. Barker line shaft motor.

This room is fed by three 600,000 c.m. cables. This is run on pole lines outside from the power house at a distance of about 350 feet.

The motor equipment in pump room is as follows:

1—250 h.p. mill water supply pump motor.
1—250 h.p. ground wood stock pump motor.
2—200 h.p. ground wood stock pump motors.
2— 40 h.p. grinder pressure pump motors.
2— 15 h.p. conveyor motors.
1—10 h.p. silver screen motor.

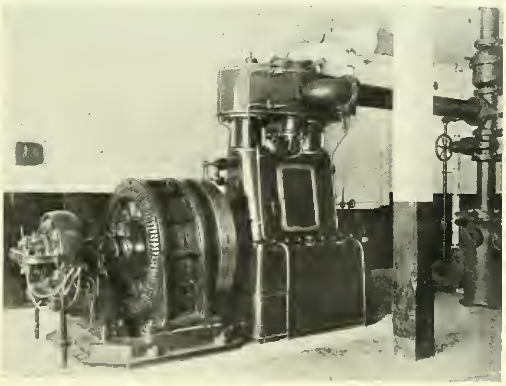
The complete motor capacity of the plant approximates 3,000 h.p. All machinery in connection with the plant is electrically driven except the large wood grinders, which are located in a room adjacent to the power house and which are driven by water turbines. The cables used inside the building are all of special manufacture, being of varnished cambric insulation enclosed in iron conduit. The entire installation is in accordance with the latest rules of the Associated Factory Mutual Fire Insurance Companies. The complete electrical installation is in charge of L. K. Comstock & Co., Montreal.

C. E. A. Officers

The officers of the Canadian Electrical Association for the year 1914-15 elected at the executive meeting held during the recent convention in Montreal are as follows:—President, Col. D. R. Street; first vice-president, D. H. McDougall; second vice-president, R. M. Wilson; third vice-president, Wills Maclachlan; honorary secretary, T. S. Young; secretary-treasurer, Alan Sullivan; managing committee, J. S. Gould, G. W. Magalhaes, P. T. Davies, H. G. Matthews, A. E. Dunlop, J. S. Norris, Geo. Kidd, Robin Boyle, W. G. Angus, W. S. Robertson, E. L. Milliken, L. W. Pratt, H. R. Mallison, G. Ratcliffe Hulme. By a unanimous vote the president of the N. E. L. A. will in future be ex-officio a member of the executive.

New Plant in Wingham

The Corporation of Wingham, Ont., recently added to its electrical plant a compact and serviceable engine-driven unit. The generator is 187½ kv.a., 450 r.p.m., 2300 volt, 3-phase, 60 cycle, with direct connected exciter 8½ kw. 125 volt, built by the Canadian General Electric Company. It is driven by a Goldie & McCulloch vertical two crank compound enclosed forced lubrication engine arranged to run either condensing or non-condensing, the condensing plant being of the jet type with direct coupled steam cylinder and air and water pumps. The high pressure valve is of the expansion type under the control of the governor through a telescopic rod, one of the advantages of this arrangement being that the position of the cut-off in the high pressure cylinder can be changed while the engine is running, if desired, or the expansion principle can be cut out altogether and the engine run on the throttle governor only. The type of governing used on the Goldie & McCulloch engines makes them very flexible when driving alternators running in parallel with other alternators driven by different types of engines on which the governing may not be as good as desired.



New Engine-Generator Set in Wingham, Ont.

as by altering the position of a stop on the expansion rod the engine can be made to take the greater share of the load itself or force it on the other engines and generators as may be found necessary or desirable.

The panel for controlling this generator, also built by the Canadian General Electric Company, forms an extension to the existing blue Vermont marble switchboard, and is equipped with 2 pump brackets, 1 a.c. ammeter with 3-phase transfer switch, 1 field ammeter, 1 a.c. voltmeter, 2 rheostats, 1 synchronizing receptacle, 1 three-phase potential receptacle, 1 field switch, 1 automatic form K3 oil switch, 1 polyphase watthour meter, 2 current transformers, 2 potential transformers. On a swinging bracket at the left side of the switchboard are mounted:—1 synchronism indicator, 1 a.c. bus voltmeter, 1 power factor indicator connected to show the power factor of the station.

The plant is in charge of Mr. H. Campbell, manager and superintendent.

Safety First

That the Safety First movement is producing real results is being evidenced every day by the reduction in the number of accidents which have come to be looked upon as necessary under certain fixed conditions. For example, our neighbors to the south have considered it obligatory in the interests of patriotism to kill off a considerable percentage of their population on July 4th by fireworks, gun powder explosions and other apparently, to us, superfluous demonstrations. This year's record, however, shows that in New York city not a single fatal accident occurred and the best reports to date show that only twelve people were fatally injured in the whole of the United States as a result of the demonstrations on July 4th of the present year. Though this figure of twelve seems to be ridiculously large it is very small compared with the fatalities of the immediately preceding years and indicates that the Safety First idea is becoming impressed upon the average mind with salutary results.

The movement in Ontario has resulted in the formation of the Ontario Safety League, which is doing increasingly good advertising work by distributing literature, by giving lectures, by moving picture demonstrations, and above all by reaching the school children and impressing upon them, early in life, that it is more important to be sure than sorry. The most casual observer will have noted the difference in the attitude of Toronto children towards hurrying across the street, rushing to the scene of an accident, approaching wires of any kind, and in many other ways. The natural childish thoughtlessness and recklessness is plainly giving place, in a very marked degree, to caution and watchfulness, a condition which Ontario's parents note with the greatest satisfaction and approval.

One of the pamphlets of the Ontario Safety League has just come into our hands and though its contents have been pretty widely advertised we print extracts from it believing that too much publicity cannot be given to this altogether meritorious movement. Particularly we wish to draw attention to the fact that the work of this league is entirely dependent upon public subscription and that such a great humanitarian movement deserves the support of every good citizen. The amount of money expended to date has not been large. There are no high salaried officials and, indeed, it may be said that the work so far has been one of love on the part of the most active and enthusiastic members and officers. Entirely aside from salaries, however, the expense of educational campaigning is necessarily considerable and the league will be grateful at all times for financial assistance to enable them to carry out their work still more effectively. Mr. J. F. H. Wyse is organizer and engineer of the league; Mr. R. B. Morley is secretary-treasurer. Temporary offices have been taken at Room 25, 34 Victoria St., Toronto.

We quote the following extracts from the bulletin mentioned above.

The Ontario Safety League is an educational organization formed late in 1913 upon the suggestion of the Ontario Railway and Municipal Board. Its chief aim is to teach the public at large to think of SAFETY as the first consideration. The campaign is being conducted along educational lines principally, as it has been clearly shown, in other cities, that the greatest reduction in accidents has been made by teaching the public to exercise constant care and unremitting caution. The success of the public safety movement in the United States is ample justification for the work in this province.

The number of accidents, fatal and non-fatal, occurring on the streets, has increased to an appalling extent in recent years. This is due to narrow streets, congestion of traffic, the increasing use of motors and other fast-travelling vehicles, together with the thoughtlessness of a large section of the public, both in vehicles and on foot. The Ontario Safety League has the following objects and, with the full co-operation of the general public, can do a great work in lessening the accidents upon our streets:—

To safeguard and protect the public, especially children, from the dangers of automobiles, railroads, street railways and all forms of vehicular traffic on the public highways in this Province.

To educate the public through schools, churches, literature and all channels of publicity upon matters pertinent to public safety.

To minimize the injuring and killing of persons employed in stores, factories, workshops and all departments of industrial and mercantile activity, by instilling into the minds of employer and employee the full meaning of "SAFETY FIRST."

To co-operate, so far as lies in the power of the League, in preventing the useless destruction of life and property by fire.

To educate and secure possible remedies and preventatives, and to assist in the enactment and enforcement of ordinances requisite to carry out the foregoing.

Local Leagues will be organized in different parts of the Province as quickly as possible. These local councils will, to a great extent, direct their own work, but will be at all times under the direction of the parent League in Toronto.

The League is entirely dependent upon public subscription to carry on this great humanitarian movement and for that reason a general appeal is being made.

The work is of vital importance to every man, woman and child in the province, and all may assist in this crusade.

The following are the different classes of membership:—

Associate Members—Twenty-five cents per annum.

Active Members—One Dollar per annum.

Patrons—Five Dollars per annum.

Sustaining Members—From Ten Dollars upwards per annum.

"Safety First"

Think just what these words mean, and then make Safety your first consideration.

Remember that it is better to cause a delay than an accident.

Don't take dangerous and unnecessary chances.

Eyes left till you reach the centre of the street, then, eyes right!

"An ounce of prevention is worth a pound of cure."

Don't run in front of a moving vehicle—that is not "SAFETY FIRST."

Help the children. Teach the young idea "SAFETY FIRST."

It is better to be careful a thousand times than crippled once.

Never board a moving car—a few seconds gained is a poor recompense for a limb lost.

Safety First, Last and Always

Outdoor Switching Equipments

By W. H. Acker and C. A. Harrington

In the natural growth and extension of a high tension transmission system the need for sectionalizing equipment on the main arteries is very soon manifest in order to facilitate the segregation and cutting out of portions of the lines which may develop trouble. The construction of tap-off or branch lines from the main circuits further increases the necessity for suitable disconnecting arrangements, such circuits being of relatively minor importance as compared with the main lines. The connections entering sub-stations, either tapping-off the main transmission circuits or served from these tap-off or branch lines must in many cases be provided with outdoor disconnecting and switching or selector equipment in order that the sub-station may be disconnected and isolated from the system in case of serious trouble or fire in same; and further, in order that the service connections supplied through the sub-station may be readily transferred by means of outdoor selector switches from one high voltage circuit to another, where double circuit transmission is used, without this service being interrupted.

It is always, of course, extremely desirable and in many cases absolutely necessary that these outdoor disconnecting, switching and selector arrangements be dependable, simple and inexpensive. Very often they are infrequently used but when needed must be operated quickly and positively, while at the same time the connected load which may be

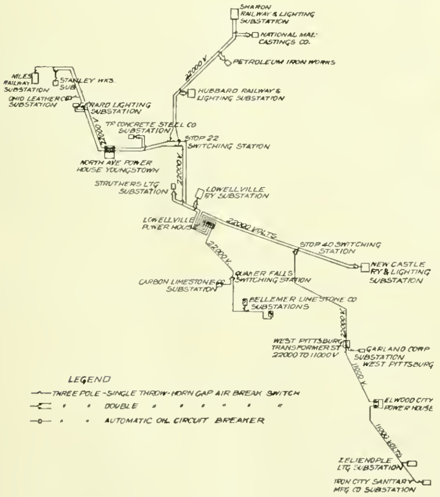


Fig. 1

fed through the switch is very small and the revenue derived therefrom would not warrant an expensive arrangement.

It is only within the last few years that the horn-gap air-break switch has come into prominent use for outdoor switching and sectionalizing of high tension transmission lines, taking care of just such conditions as are above outlined.

On the transmission system of the Mehoning & Shenango Railway & Light Company, Youngstown, Ohio, there are eighteen such outdoor air break switching stations and a total of thirty two-three single-throw and one-three double-throw horn gap air break switches installed on same. Typical stations on this system are illustrated herewith.

Fig. 1 is a one-line diagram of the transmission system showing locations of outdoor air break and indoor oil switches. Under normal operating conditions the power stations at Youngstown, Lowellville and Ellwood City are operating in parallel through the transmission system, the main portion of which is double circuit. Automatic oil circuit breakers are provided on all high tension feeders leaving the various power stations, and all synchronizing of power stations into the system is done across these oil circuit breakers.

All outdoor switching is taken care of with the horn gap air break switches.

The air break switching stations consist of a suitable timber framing on which the switches are mounted, and an

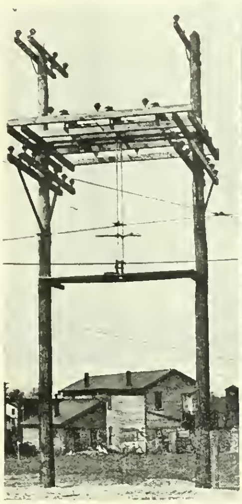


Fig. 2

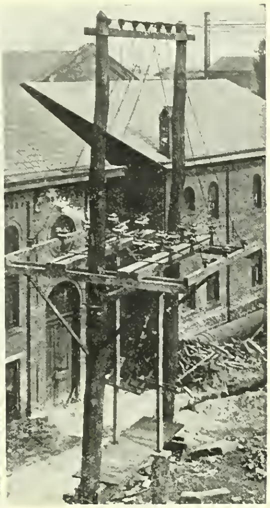


Fig. 3

operating platform located from ten to twelve feet below the switch framing, from which the switches are operated. In most cases the switching station is supported from ordinary wooden poles. The arrangement of the switches, wiring and operating handles varies considerably and depends entirely upon the operating conditions, all switching stations being duplicates where the same conditions have to be cared for. The handles for operating the air break switches are all of wood, grounded galvanized iron pipe operating mechanism, previously used, having been replaced in order to eliminate the grounding of the metallic frame of the switch. In some cases these wooden operating handles are arranged so that they interlock the two air switches on the platform in such a manner that both switches cannot be in a closed position at the same time, thus making it impossible for the two transmission circuits to be paralleled at stations so equipped. At other switching stations where it may be desirable to parallel the two high voltage circuits while transferring the load from one circuit to the other, the interlocking of the operating handles has been omitted.

The following photographs of several different switching towers designed to meet various and very different operating conditions, show how readily the horn gap air break switch can be adapted and arranged to take care of disconnecting, sectionalizing and selector switching problems.

Fig. 2 shows a switching tower on which two switcches are mounted. The double circuit transmission lines come onto the tower just below the framing on which the switches are mounted and the single circuit into the sub-station leaves the tower on top. The galvanized iron operating rods have

since been changed to wood. The handles operating these switches are not interlocked and the station attendant may parallel the transmission circuit upon receipt of the necessary orders. In case of power interruption the switch which is closed may be opened and the other switch may be closed and service resumed without waiting for orders.

The switching tower shown in Fig. 3 was designed to take care of the same conditions as in Fig. 2, with the exception that it was necessary to bring the two high voltage transmission circuits in on the top and run the single circuit into the sub-station from below the framing for the switches. A large number of the switching towers are duplicates of Fig. 3.

Fig. 4

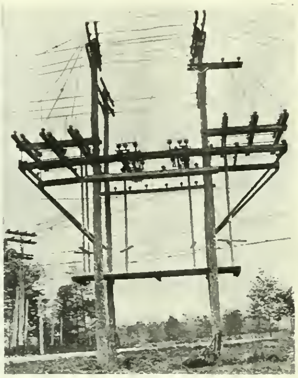


Fig. 5

The switching station shown in Fig. 4 is mounted on top of a steel frame factory building, the sub-station apparatus being located below on gallery floors. Two three-pole single-throw air break switches are mounted on the wooden framing on top. The two transmission circuits come on to the structures below the switches, and on the outside.

The single circuit from the switches to the roof bushings leaves the structure below the switches, and is between the two transmission circuits. The wooden operating rods for the switches are interlocked by means of the horizontal operating handles, so that the two switches cannot be in closed position at the same time, thus paralleling the two transmission circuits.

The view shown in Fig. 5 is of a sectionalizing switching tower at the junction of six three-phase transmission circuits. Six three-pole single-throw air break switches are used and are arranged so that any circuit leaving the tower may be cut out independent of the other circuits. No arrangement for paralleling the circuits is provided, the duplicate transmission lines being independently sectionalized on opposite ends of the tower.

The Outremont, P.Q., council have awarded a number of contracts in connection with their proposed public lighting and fire alarm and police signal systems. The order for 1200 nitrogen filled lamps was given to the Northern Electric Company, and that for six regulating transformers to the Canadian General Electric. Mr. G. M. Gest obtained the contract for erecting 125 combination trolley and lighting standards and 375 lighting standards, and for laying 74,800 feet of single conductor cable, 22,440 feet of two conductor cable and 19,000 feet of lead covered cable. The contract is on a ten per cent. commission basis. The Northern Electric will supply the apparatus for the fire alarm and signal system, for $11,291, the total cost of the work being estimated at about $17,000. Dr. L. Herdt is the consulting engineer.

Aluminium Insulated Cables

By E. V. Pannell, A.M.I.E.E.

Doubtless many engineers who have called for alternative tenders for copper and aluminium cables have been disappointed to find that the quoted prices do not show the economy in favor of the latter that might reasonably be expected, taking into account the current market rates of the two metals. It does not necessarily follow, however, that the cost of producing an article has any direct bearing on the selling price. An analysis of the comparative manufacturing costs has therefore been made, and the results checked with the terms upon which business has actually been placed, and it is suggested that these figures throw light on the true economic relationship between copper and aluminium cables.

The three main objections which are raised against the adoption of aluminium for insulated cables may be briefly set forth as follows:—

(1) That the economy is doubtful;

(2) That the metal is difficult to work and joint;

(3) That the scrap value is low.

Were these assertions sustainable it would be unnecessary to proceed with a detailed analysis, and it is therefore proposed to deal with them at the outset, with a view to satisfying financier and engineer alike that the subject is worthy of investigation to a logical conclusion.

Economic Considerations

The specific gravity of annealed aluminium wire is 2.71 and that of copper 8.89; for a given volume, therefore, copper is approximately 3.3 times the weight of aluminium. The average conductivity of aluminium supplied for electrical purposes being 61 per cent. of the International Resistance Standard for copper, it follows that the sectional area will be 1.642 that of a copper conductor of the same length and resistance. The weight ratio on the basis of equal resistance is therefore copper, 3.3; aluminium, 1.642—or approximately 2 to 1. That is to say, for every 2 lbs. of copper, 1 lb. of aluminium will do the work, and the latter must therefore show a definite saving at anything under double the market price of copper.

At present average rates the price of Aluminium exceeds that of copper only by some 30 per cent., and thus it will be clear that a substantial margin of economy is assured by the employment of aluminium in place of bare copper strand.

Admittedly the insulation and protection of such conductors places a modified aspect on the question of economy, the larger diameter of the aluminium core postulating a relatively larger area to insulate. But the initial saving on the strand, even in the smaller gauges, will as a general rule be found to meet this extra expense with a useful balance in hand, while it will be obvious that as the area of the conductor increases the greater does this economy become and the more apparent the advantage in specifying aluminium. Take a typical instance where an electrical company decide to augment their distribution system by, say, 7½ miles of 600 volt paper insulated, lead covered and jute compounded feeder cable, of 1 sq. in. sectional area in copper, manufactured to the specification of the British Engineering Standards Committee. With copper wire at 9d. and aluminium at 11d. per lb. respectively, the relative cost of the cable, allowing for an equal ratio of profit on wages and raw material, would be:—

Copper cable, per mile	£1120
Aluminium cable, per mile	860
Balance in favor of aluminium, per mile	£260

or £1950 on the 7½ mile section, a saving of 23 per cent. on the cable. Where ducts do not already exist, the additional capital required for these and for labor charges, joint boxes,

etc., will reduce the above percentage to approximately 15 per cent. economy on the complete installation, subject to slight modifications depending on the particular system of cable laying adopted.

It is true that heavily armoured high tension cable will not show aluminium to the same advantage, particularly when the cores are of relatively small cross section. But, ignoring for the moment the technical superiority of a large core in dealing with high pressures, the fact remains that even in this class a valuable saving may be effected, a fact that Continental engineers have taken full advantage of in large contracts recently placed.

Perhaps this is best demonstrated by assuming that the electrical undertaking, before mentioned, desire to increase their supply facilities by about 6,000 kw., and that economical considerations decide in favor of obtaining this power in bulk from a neighboring station. Allowing for 7½ miles of 3 core, 6,600 volt cable, insulated with impregnated paper, lead covered and double steel tape armoured, designed for laying direct in the ground, the cost per mile of such cable on the same basis as in the previous example, would be:—

Copper cable, per mile	£1912 0 0
Aluminium cable, per mile	1809 10 0
Balance in favor of aluminium per mile.	£102 10 0

or £768 15s 0d. on the 7½ mile section, a percentage economy of nearly 5½ per cent. In addition, the larger aluminium core increases by some 10 per cent. the over load capacity, and materially reduces the stresses on the dielectric. It should be borne in mind that where extra high pressures are called for, it is necessary in any case to increase the diameter of the core, in order to avoid undue stress; this point alone led to the installation of an E. H. T. aluminium feeder on the Prussian States Railways at Dessau-Bitterfield.

It may here be contended that the above results are obtained on figures unduly favorable to the cause of aluminium. There are, however, two sides to this argument, for the fluctuations in the prices of the various materials frequently bring aluminium into a decidedly more favorable light than in the instances outlined above. A recent illustration of this point is seen in the cable installed by the Metropolitan Electric Supply Company, Limited, London, in connection with the extension of their 600 volt feeder system. After careful consideration of all aspects of the case, a triple concentric paper insulated lead covered aluminium cable was decided upon, the segmental cores having an area of 0.83, 0.83 and 0.33 sq. in. respectively, a decision that resulted in a saving over copper of £345 per mile.

Jointing Problems

The jointing of aluminium in the early days of its application to electrical work presented problems outside the experience of the general run of engineers; and results were not so consistently satisfactory as to meet the high standard of reliability required in electrical engineering. But while this fact has received wide publicity, it is not so generally known how completely the initial difficulties have been overcome in modern designs of joint for aluminium cable work.

Jointing of Cables

While soldered joints have been adopted with more or less successful results upon one or two aluminium installations, experience goes to prove that suitably designed mechanical connectors meet more closely the requirements of the case, and satisfactorily withstand the test of time. Cast welded joints, being practically pure aluminium, are electrically perfect, but the intense heat renders it necessary to bare the conductor back to a considerable distance to avoid injury to the installation, and unless the workman has some skill in this line the whole process involves an unnecessary waste of time. On the whole, therefore, the jointing problem is best solved in the use of mechanical connectors These connectors are "stepped" in order to ensure that an intimate contact is evenly distributed between all layers of the conductor, a condition not otherwise easy to attain owing to the difficulty of squeezing out the film of impregnating oil. A rough machined surface in aluminium permits of an excellent contact between clamp and wires on the application of pressure. This type of joint is much in use in England, being a later modification of that designed by Mr. S. L. Pearce, Chief Engineer of the Electricity Department, Manchester Corporation. It is approximately cylindrical in cross section, and has been designed for minimum overall dimensions consistent with mechanical strength and electrical efficiency, to obviate the necessity for joint boxes larger than those commonly in use for copper cables.

A more adaptable type of connector for jointing sector cores takes the form of a sleeve connector, with numerous set screws which bed into the strand. This is a design that finds considerable favor on the Continent. It may be safely stated that if these joints are efficiently made in the first instance, the connectors firmly screwed up, and the box filled with compound to prevent access of moisture, they form permanently reliable units as free from trouble as any other individual member of the distribution network.

A system of jointing that, in view of its satisfactory operation in connection with overhead line work, would appear to promise well as applied to insulated cables is the compression joint. This type has been successfully developed in the States and Canada, and consists of a stout sleeve of aluminium bored out to receive the two ends of strand to be connected. The sleeve is then compressed at short intervals throughout its length by means of a small hydraulic press, and the joint thus formed is stated to be of lower electrical resistance and mechanically stronger than the cable.

Service leads, etc., may be tapped off by means of Tee connectors embracing only the outer layer of the strand, provided the length of connector as measured along the feeder is at least five times the diameter of the service lead. In connecting up copper services to aluminium distributor cables, clamps terminating in a flat contact should be arranged for wherever possible, and these should preferably be filed at right angles, and after firmly bolting together, should be painted or otherwise rendered moisture-proof in order to avoid galvanic action between the two metals.

Single wires may be quickly and efficiently butt welded in the flame of a blow lamp, the flame being given a reducing or deoxidising effect by restricting the amount of oxygen to rather below that required for complete combustion. The two wires to be joined are kept in a straight line, and a gentle pressure exerted when fusion commences, when the flame should be immediately withdrawn.

Scrap Value

Provided the cost of producing an aluminium cable be placed upon an equal footing with the copper equivalent, it will be found in practice that the profit gained in the first instance capitalized over the usual life of a cable, say from 20 to 30 years, will more than meet any difference that may exist in the relative scrap rates of copper and aluminium. An illustration of this point may be seen on referring back to the L.T. cables instanced under "Economic Considerations." The net economy over copper on the 7½ miles of aluminium cable amounted to £1950, which at 4 per cent. over a period of 20 years—the minimum useful life of the cable—becomes £4285. To this sum must be added the value of some 25 tons of scrap lead in excess of that utilized in the copper equivalent, which at £17 per ton will be £425, or a total of £4710. The value of the copper scrap at £61 per ton would be £4220, and we therefore have £490 to the advantage of aluminium, even if the scrap value of this metal were nil.

As a matter of fact there is little difficulty in disposing

of aluminium scrap, either in this country or on the Continent, provided the history of the metal is known. It will be readily understood that it is essential that the highest standard of purity be maintained in metal for electrical work, and this fact naturally causes producers to hesitate in the purchase of scrap metal, when practically anything in the nature of white metal is referred to as aluminium.

There are certainly contingencies that arise in connection with collieries and similar enterprises, where a valuable cable may be laid for a comparatively short period. In such cases it is surely more a matter of salesmanship than of relative scrap price of the two metals, for a colliery owner would no more sell a 3-core armored cable as scrap aluminium or copper than he would sell a triple expansion engine as scrap iron. Here is a cable designed and guaranteed to transmit a certain load with a minimum of loss and depreciation, and a man in the market for such a second-hand length will be inclined to consider what it will do, rather than what it is made of. If, therefore, he knows that aluminium will not only do the work plus an additional overload capacity of 10 per cent., but will also be consiedrably lighter on supports in shaft and workings, it is rational to suppose that he will give a percentage of the initial outlay at least as high as would be obtained on the copper equivalent.

In the foregoing, the questions most frequently raised have been dealt with as briefly as possible. Other doubts may occur, but these are usually indicative of a natural clinging to the more familiar metal, rather than of any active prejudice militating against the development of aluminium. Such opposition as does arise is mainly traceable to copper interests, or to wire and cable manufacturers who can only perceive in aluminium a reduction in turnover, and the necessity of adapting their methods and standards to the more economical metal. But whatever the position aluminium is ultimately destined to take up with regard to insulated cable work, the present wide interest in the subject cannot be denied.

Sterilizing Water by Electricity

Using the Ultra-Violet Rays of the Mercury-Vapor Quartz Lamp

By M. von Recklinghausen*

Within the last five years a new field for the application of electricity has been created in Europe based upon the electrical production of ultra-violet light for the sterilization of water and for other purposes. As this new industry is now being introduced into this country, it is of interest at this time to analyze its basis and principles.

The experimental and development work in this field has been done mainly in France, and prominently identified with it are the names of Courmont, Nogier Henri, Helbronner, von Recklinghausen, Vallet and others. This paper deals particularly with the work done by the writer in collaboration with Messrs. Henri and Helbronner at the Physiological Laboratory of the Sorbonne University.

The Source of Ultra-Violet Light

The only industrially-applied source of ultra-violet light is the mercury-vapor quartz lamp. The spectrum is known by its bright lines in the visible part and by a large number of typical lines in the ultra-violet part.

When starting this work we soon found that we had to go pretty fully into the question of the measure of the ultra-violet power of the different light sources at our disposal, so as to give the mercury quartz lamps the electrical characteristics which made them most useful for the creation of ultra-violet light. It is a well-known fact that the skin takes a less ghastly hue under the quartz mercury lamp than under the ordinary mercury-vapor lamp. Spectroscopic examination shows that this is due to a considerable increase of the intensity of the red lines in the spectrum of the quartz lamp. This phenomenon was examined somewhat more closely, with the following results:

An ordinary 110-volt lamp was taken, which normally operates at 3.5 amperes and 80 volts; it was operated at different wattages, obtaining thereby, naturally, different temperatures of the mercury arc. A spectro-photometric analysis was made of the five principal colors, composing the visible light of these lamps. Assuming the intensity of each color at the lowest wattage as unity, we note that increasing the wattage of the lamp tends to increase the red more than the other colors. It might therefore be expected that the increase of the ultra-violet rays with increasing temperature of the lamp, would be somewhat like the increase at the violet end of the spectrum, that is to say, proportionately less than at the red end. As will be seen from what follows, this is not the case. There is obtained, on the contrary, a considerably greater increase in ultra-violet than in violet rays with increasing temperature of the lamp.

Sterilizing Apparatus

The most efficient way for the mercury lamp to react upon water seems to be, a priori, to submerge the lamp entirely in the water which is to be sterilized. Direct contact, however, of the water with the heated lamp influences the luminous and ultra-violet efficiency of the quartz lamp to an enormous degree. It seems to be certain, therefore, that it is better, if one wants to plunge the light source into the water, to protect the lamp from direct contact with the water, and this system has been adopted with modern apparatus. This protection against direct contact can be secured by fusing over the lamp a wide quartz jacket which prevents contact of the light-giving portion of the lamp, with the water.

Difficulties, however, arose in the manufacture of such jacketed lamps and it was found advisable to construct the apparatus in such a way that the lamp was removable from the protective jacket, allowing, nevertheless, all the light to enter the water. Another method is to let the water circulate in such a way around the lamp that it would not come into contact with it, receiving nevertheless practically all the rays emitted by the lamp.

Where it is more a question of convenience and less a question of efficiency the simplest method is evidently to place the lamp above the water but as close as possible to its surface. Unfortunately, reflectors placed above such lamps have a low efficiency in reflection of ultra-violet rays. It may therefore be said that with such apparatus hardly half the rays of the lamp will enter into the water.

Contact of the Rays with the Germs

Different germs have different sensibilities to the ultra-violet rays. The ones of greatest interest to us are the water bacteria and we find that they are killed in as short a time as 1/20 second, at a distance one to two centimeters from the powerful ultra-violet ray lamps. Water being practically as transparent as air to the ultra-violet rays, we are therefore certain that if a germ floats in the water it will be annihilated by getting into the illuminated zone, the condition for this being that no suspended matter is contained in the water which would form a shield for the germ.

Water for this sterilization has, therefore, in most cases to be filtered before being submitted to the sterilizing action of the rays. However, even very good filters will allow some microscopic matter to pass. It is much more effective, as shown by experiments, to stir up such water while it is going through the illuminated zone so as to turn over and over any particles which otherwise might allow microbes to pass by under cover. For the same reason, also, it is best to pass

*Extracted from paper presented before A.I.E.E.

the water through several illuminated zones, which can easily be done by leading the water several times towards the same source of light, or by passing it successively under several sources of light.

Typical Installations

The largest unit ever built was set up about two years ago in the city of Luneville, France, to sterilize the city water supply. It consists of a flume into the sides of which ten 500-volt pistol lamp equipments are inserted. These equipments consist of metal boxes for the starting of the lamps (the latest types of them contain also the rheostats). The boxes are equipped on the inside with a stuffing box arrangement holding the quartz protective tube which protrudes into the water. The lamps are lit in the starting boxes and then their luminous parts are inserted into the protective tubes, so that the light emitted from the lamp enters the water.

The raw water fed into this plant comes from the Meurthe River and contains sometimes as high as 60,000 germs per cu. cm. It is clarified by a series of roughing filters and one filter. After this it is physically in fairly good condition, being very poor in suspended matter, but having from time to time fairly deep color (up to 45 U. S. standard) in solution. The germ contents are sometimes as high as 1,000 per cu. cm. in this water. It is then passed through the sterilizing unit described above, coming under the influence of the light from one to two minutes altogether, according to the number of lamps running. This number (sometimes only 4) depends on the physical condition of the water, which is easily observed. The bacteriological tests of the water when leaving the sterilizer rarely show more than 10 germs per cu. cm. and are often zero. Bacterium coli is always eliminated. Not only are the bacteriological tests satisfactory; the health of the community has improved considerably. Typhoid used to cause from 70 to 100 deaths annually; it is now practically eliminated, there being no cases at all this year.

Another typical installation was made in New York lately for the purification of the water of a swimming pool, which is naturally exposed to continuous pollution from the bathers. The water in this case is circulated continually through a filter to take out suspended matter and then it passes through the ultra-violet ray sterilizer. This apparatus is similar to the Luneville unit except for its size, as it contains only two 220-volt pistol lamps. It is rated at 175,000 gallons capacity per day. Tests at the outlet of the sterilizer show only a few germs, and tests of the water going to the purifying apparatus have improved from 6,000 germs per cu. c.m. to about 350 germs per cu. c.m. since the introduction of the ultra-violet ray apparatus.

Consumption of Electric Energy

The smallest lamp used in the above apparatus operates at 110 volts with two amperes. The largest made so far is for 500 volts, 2.5 amperes. The largest apparatus built contains ten of the last-mentioned lamps. The power consumption in such a case, with a very large safety coefficient for the sterilization, is between 50 and 130 kw.h. per million gallons of water. This amount of power is evidently not very great but it will always do something to smooth out the load curve of a power station, as, in most cases, such apparatus will be operated continuously. Many installations of this kind have been made in Europe for both small and large waterworks, and they are operating very successfully. Their simplicity and rapidity of action are highly satisfactory.

Returns of the May operations of the B. C. E. R. Co., just made public, showed that the number of passengers carried during that month was 3,370,943, as compared with 4,267,250 for the same month in 1913, a decrease of over 20 per cent.

Touring by Electric Automobile

By J. S. Codman

Has the day of the electric touring car arrived? Or, if not, how far distant is it and what must yet be done to hasten its coming?

We cannot yet say that the day has come, but on the other hand it is now close at hand and the obstacles still in the way are neither many nor great.

Already the electric has ceased to be merely a town car. In addition, it is now the ideal runabout both for city and country work. It is more convenient, more dependable, more comfortable and cheaper to operate than a gas car, and within the last few years has been so developed that actual road runs of 70 to 100 miles have been made at a speed considerably greater than the usual road speed of the gas car. To prove this last point a list of various runs made in New England between different points has been published, and probably all New England men who are familiar with one or more of the roads, know about how fast a gas car can comfortably make the distances. All of these runs were made with stock cars and each one was on a single charge of battery.

As regards touring, the electric has sufficient speed, and two notable tours made within the year show also that rough, muddy, and hilly roads and bad weather are not real obstacles.

Last summer a tour of between 500 and 600 miles was made in an electric through the Green Mountains of Vermont and the White Mountains of New Hampshire, and no difficulty was experienced, either on the steep hills nor on the rough or sandy country roads. The distance from Boston to Burlington, Vt. (258 miles) was made at an average speed of 19 miles per hour. The route taken was through Fitchburg, Ashby, Jeffrey, Dublin, Marlboro, Keene, Walpole, Bellows Falls, Springfield, Walpole, Rutland, Brandon, Middlebury, New Haven, and Vergennes, and motorists who have been over this route will recognize that some parts of it present many difficulties. The slowest run was from Keene, N.H., to Springfield, Vt., 42 miles, 16.7 miles per hour and was made almost entirely after dark. The fastest section covered was from Boston to Fitchburg, 21.3 miles per hour. The 78 miles from Rutland to Burlington (including detours) was made at exactly 20 miles per hour.

An even more notable run was made last October from Boston to Chicago during the worst weather of the season which turned many of the roads into sloughs of almost impassable mud, but again no greater difficulty was experienced than might be expected with any car under such circumstances.

Some of the data of this trip is given below and especial attention is called to the high daily mileage and high average speed obtained whenever fair conditions of road and weather were encountered.

The car left Boston, October 14, arriving in New York the next day, where it was then exhibited for three days at the Electrical Show. It started for Chicago, October 19, and ran some part of every day with the exception of Sunday, October 26, when a rest was taken at Cleveland.

The minimum daily mileage was 18 between Albany and Schenectady, following the failure of the garage in Albany to properly charge the car; and the maximum daily mileage was 173.5 between Syracuse and Buffalo, where good roads and good weather were in combination. It will be seen that an average speed of 20 miles per hour was readily attained under fair conditions, while between Springfield and New Haven it was 23.6 and between Rochester and Buffalo, 22.8. The average speed for the whole distance is obtained by dividing the total miles, 1,302.5, by the total hours consumed

in running between points, viz., 33.5 hours. This gives an average speed of 15.6 miles per hour, which is certainly remarkable considering that no time at all is taken out for road stops.

The latest remarkable trip in an electric automobile was made in the early part of this month, and for the first time on record an electric automobile left Boston and arrived in New York in less than 24 hours.

If then, the electric automobile is not lacking in speed and is fully capable of meeting all road conditions, what then are the obstacles to its use for touring? As is evident everywhere, it is the difficulty in getting charged on the road. This difficulty, however, is not to any great extent a difficulty inherent in the car itself. It is true that a battery cannot be filled as quickly as a gasoline tank, but on the other hand, the delay is not great if proper facilities can be obtained. Boosting a battery at high current rates is perfectly practical to-day. The Edison battery is notable in this respect and even lead batteries, it is now understood, can be charged without injury at much higher rates than was formerly thought possible if only proper care is taken to reduce the rate before the gassing point is reached.

I have myself on one occasion out on the road boosted a battery at 200 amperes for one hour. This battery was composed of Edison A-6 cells rated at 45 amperes normal current and it absorbed in that hour enough charge to have carried me about 50 miles. On this occasion my cable was passed through the window of the electric light station and connected directly on the exciter bus and very little time was lost in getting connected.

The overcoming of this great obstacle to touring with an electric is something we must leave largely in the hands of our central friends. Generally speaking, they are most willing to help when an emergency arises, but this does very little real good. What is needed is apparatus all ready for use and someone about the premises who knows what ought to be done.

Now of course there are Central Stations which provide ample and convenient charging facilities but they are very exceptional. In most of the small towns and even in many large cities proper facilities for charging are either non-existent or are very inadequate.

Taking New England for example, Massachusetts is, as compared with the other states, well-equipped with charging facilities and yet what are the figures? McCraw's Central Station Directory reports over one hundred (114) electric light companies operating in over 300 of the 333 towns and cities in Massachusetts. On the other hand the list of charging stations compiled by the Electric Motor Car Club, after a canvass of all the garages and electric light companies, indicates only 53 towns in which the charging stations are supposed to be located, and only 28 towns where more than 50 amperes can be obtained.

It would certainly seem that where there is in a town no public charging station capable of giving an adequate boost, at least 100 amperes at 125 volts, the electric light company itself should have ready for use a service connected with the exciter bus. This service should consist of a switch, fuses and terminals for connecting to the cable and charging plug which every motorist should himself carry. A cheap resistance coil for controlling the current it would also be best to have ready, but often even this is unnecessary especially when the Edison battery is used. Measuring instruments are not necessary, as it is the service rather than the amount of current which should be charged for, and further an approximate measurement can usually be made by means of the instruments on the car itself. Such an outfit would be very inexpensive.

Now in the face of records of this kind, it is time for the central station man to do his part, and if he cannot arrange a neat little installation of battery-charging equipment by using his exciter for this service at a cost which is too small to consider he must be indeed lacking in enterprise. It ought not to be necessary for an electric automobilist to telephone ahead from a point several hours run away in order to secure the required charge on arrival. We are inclined to think that most central station men will go out of their way to accommodate the cross-country driver of an electric automobile in the particular rare instances when such a machine comes along; but what is really needed is a readiness-to-serve policy which will make the purchase of a charge as simple a matter as the buying of five or ten gallons of gasoline from the village grocery—a continuous availability of the charging apparatus at all hours and at a fair price. With the increase of day service even among the smallest central stations the time has passed for indifference or sluggishness in the matter of being ready to charge vehicle batteries at 2 a.m. as well as at 6 p.m. through simple home-made flexible connections and resistances whose cost is nominal. Of course, the electric automobiles will not come until the small central station is prepared to charge them; the latter must get into line and be ready for the business, and the ultimate profits are already clear to the far-sighted student of electric vehicle development.

Table I.

Runs Made by Various Electric Automobiles on One Charge of Battery

	Miles	Time	Aver. Speed
Boston to Pawtucket, R.I., and return (78 miles) remainder of run about Boston	103.2	5.075	20.14
Boston to Springfield	93.4	4.55	19.00
New Haven to New York	78.4	3.51	20.4
Rochester to Buffalo	77.0	3.45	20.5
Brookline & Groton, Mass., and return	74.0	4.01	18.4
Springfield, Mass., to New Haven, Ct.	66.1	2.48	23.6
Boston to Wareham, Mass.	58.0	2.47	20.8
Worcester, Mass., to Springfield, Mass.	51.7	2.08	24.2
Boston and Fall River	49.9	2.37	19.1
Geneva, N.Y., to Rochester, N.Y.	46.0	2.01	22.8
Brookline & Amesbury, Mass., via Haverhill	45.0	2.12	20.5
Boston and Worcester	42.5	1.46	24.0
Boston to Lowell, Mass.	25.9	1.12	21.6
Springfield, Mass., to Hartford, Ct.	27.3	1.03	26.0
Brockton, Mass., to Boston	21.8	1.05	20.2

Table II.

Boston to Chicago Tour in Electric Roadster

Summary of Daily Mileage

	Miles
Oct. 14—Boston to New Haven	161.0
Oct. 15—New Haven to New York	78.4
Oct. 19—New York to Albany	150.3
Oct. 20—Albany to Schenectady	18.0
Oct. 21—Schenectady to Syracuse	129.8
Oct. 22—Syracuse to Buffalo	173.5
Oct. 23—Buffalo to Erie	104.3
Oct. 24—Erie to Ashtabula	45.0
Oct. 25—Ashtabula to Cleveland	59.6
Oct. 27—Cleveland to Fremont	86.3
Oct. 28—Fremont to Wausem	67.3
Oct. 29—Wausem to Kendallville	64.6
Oct. 30—Kendallville to South Bend	61.0
Oct. 31—South Bend to Chicago	103.4
Total	1,305.5

The Question of Public Relations

By Thomas N. McCarter*

The trouble with this street railway proposition is that most people do not know anything about it. If we who are versed in this business should undertake to tell them as much about their business as they with great nonchalance tell us about ours, they would quickly inform us that we were talking about things we knew nothing of. With what I say on this subject, I have no false modesty. I speak whereof I know, taught in the school of hard experience.

A 3-cent Fare Inadequate

I start with the direct proposition that it is impossible, under present-day conditions, to operate an up-to-date street railway in this country, pay operating expenses and earn interest on the actual cost of the investment on a 3-cent fare. Why this demand for a 3-cent fare? Have the gentlemen who so clamor for such a fare worked it out scientifically? If I understand the principle of rate regulation at all, it is that electric railways, being quasi-public bodies, must be allowed to earn, in exchange for the franchise grants, only a fair return upon the value of the property devoted to the public use. Who has told these gentlemen that a 3-cent fare will do that? Why is it that they clamor so loudly for a 3-cent fare? Why do they not make it 2 cents or 1 cent? It is simply a will-o'-the-wisp, a happy catch word of the politicians.

While I accede entirely to the proposition that in the long run one catches more flies with molasses than with vinegar, and I am willing to go to the limit in endeavoring to placate even those whose intelligence I may not respect, I do not propose that the interests I have in hand shall be ridden over rough shod by the demagogues and the cheap politicians without a fight. I venture to say that of those in authority clamoring after this fare at the present moment, there is not a single man, in this city or elsewhere, who can tell you the basis of his belief, other than that the companies under discussion are public service corporations, that fortunes have been made out of those properties, perhaps improperly, in the past, and that, all things considered, 3 cents is enough for them. The whole 3-cent fare agitation is uneconomical and unsound, and as soon as the people of this country get that in their minds the better for everybody, including themselves.

The railway property of the Public Service Corporation of New Jersey has gross receipts of approximately $16,000,000 a year. We furnish with transportation all of the larger cities of the State of New Jersey, with the exception of Trenton, and many of the smaller ones. We operate large city, suburban and interurban properties. We have a straight 5-cent fare with a very liberal transfer privilege, so that the county rather than the city is largely our 5-cent fare limit. To that extent we are liberal. Sixty per cent of a 5-cent far is 3 cents. In 1908 our vast system was operated for 61.7 per cent of its gross receipts. In 1909 it was operated for 59.1 per cent of its gross receipts, in 1910 for 60 per cent, in 1911 for 62 per cent, in 1912 for 63.6 per cent, and in 1913 for 63 per cent. Where would we have been with a 3-cent fare? We would not have paid operating expenses, except in one year, when we would have had 0.9 per cent over.

Some one will say that the 3-cent fare will very largely increase the receipts because of the large increase in the riding habit over what it would be with a 5-cent fare. It is not so. We have just been through an experience of this character in our gas business. For many years our average increase in the output of gas has been 7 per cent. A year ago the Public Utilities Commission of New Jersey reduced the price of gas from $1 to 90 cents per 1,000 ft. and they and the people of New Jersey said that we would more than make up the decrease in price through the increase in consumption. The first year, under the 90-cent gas rate, we increased a little over 6 per cent, or less than the 7 per cent average of the preceding ten years. The same result was demonstrated in the New York Consolidated Gas Company matter, where the price of gas was reduced from $1 to 80 cents with absolutely no abnormal increase in consumption.

Hazards of the Industry

We are at the parting of the ways with these industries in this country. I am not an apologist for the past.

I know money was made out of public utility properties in the early days, and that some things were done which would not be countenanced now. I am not so sure that they were wrong. You must remember the electric railway industry is only twenty-six or twenty-seven years old. I still adhere to the principle that a man who has the hardihood to venture his money in a new and untried art that develops and changes over night, is entitled to make a good profit, something more than interest on his money. If he were not entitled to such a profit, he would be a fool to go into the enterprise. It is easy when success is assured to begin to talk about cutting down the rate of return to something more nearly normal, but when you are talking about the industry that in only twenty-seven years has almost revolutionized transportation in the world, it is too soon to begin to cry "Wolf" and to attack the early investors because they have made money out of it.

When this country wanted a transcontinental railroad built, it held out very great inducements to the promoters who would build it. Among other things, the government gave thousands of acres of land along the line of the Union Pacific Railroad. After the Union Pacific became a success, it undertook to take the land back. Was that fair? Did not the men who had the hardihood to go into that enterprise have the right to keep this land? They did, and the United States Supreme Court said so. It is the same thing in this matter of ours. A few years ago some gentlemen had the hardihood to build tunnels under the Hudson River, connecting the States of New York and New Jersey. Nothing has ever been done that has been as great a boom to New Jersey as the making of these tunnels, but the venture has not been a success. The property has had to be readjusted, and the bonds which were issued only for investment have had to be scaled down, half being mortgage bonds and half being income bonds. The company is now earning interest on the mortgage bonds and hopes some day to earn interest on the others. Will anyone say that those gentlemen who had the temerity to put their money in the bowels of the Hudson River and connect the great States of New York and New Jersey by rapid transit, should, if their enterprise ever does prove successful, be limited to a 6 per cent return on their investment? If this is adopted as the policy of this country it certainly means to say that no such enterprise will be established, for no man will be fool enough to undertake the risk and hazard of such an extraordinary enterprise under such conditions.

Would any of you take a franchise to-day for air-ship work and put your money into it? Would any of you back an enterprise that had transportation between here and Detroit by air for its object? It is not any more unlikely, thirty of forty years hence, that there will be such a means of locomotion between here and Detroit than it was thirty

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years ago that street railways would be what they are to-day. If you and I had the hardihood to back an enterprise of this kind and we waited until the people began to use it, would we not be entitled to more than 6 per cent. on our investment?

Fair Return for Established Property

After a property has become established, as ours is at present, though not firmly, a different problem presents itself. There should be no extraordinary or improper return, but the return should always be substantial and above the legal rate of interest. Otherwise I, for one, who have some idea of the annoyance and responsibility of this work, would leave my money in a savings bank or take a mortgage on real estate, and leave the troubles of this business for someone else. What is a fair return on the hazards of the business? I cannot say, but I know it must be sufficient to attract capital. It must be sufficient to keep the property developed up to the needs of the city, and, by and large, it should never be less than 8 per cent. on the value of the property devoted to the public use. Otherwise capital will flow elsewhere into different channels with less hazard. Any community that seeks to pare down the return below this point hurts not only the traction company but more especially itself.

When I was president of the American Electric Railway Association, I went from one end of the country to the other making speeches. The great value of this was that I saw how the different properties were operated and how they were developing the cities of the country, and I say without fear of contradiction, no one other single element that has arisen in the last twenty-five years has so developed the American city as have the electric railways of this country. And they will go on developing this country if they are allowed to. Just think how they have revolutionized the lives of the people of the cities. Just think how they have made it possible for men of moderate means to live in the suburbs and to own their own homes instead of living in congested centres in tenements. All has been done with a maximum of a nickel fare, throughout the length and breadth of this land, and yet the cry goes up that we are robbing the poor people and robbing the country, when as a matter of fact we have not only done this development work but have also created untold amounts of wealth for the individual property owners, and also for the cities themselves through the medium of the increase in tax values. It is such a mistaken point of view for municipalities to try to draw the last drop of blood and insist upon the last pound of flesh. How much better it would be, instead of the turmoil that is in Toledo at the present time, to have a company allowed to go on in its own way, regulated, with rates so that the return would be commensurate with the service rendered, but so that the company could get the necessary capital to develop the city. How much better would every individual be if that were the case, instead of having the present condition prolonged to an indefinite future, with a saving once or twice a day of some portion of a cent.

Results of 5-cent Fare in New Jersey

I said we had in New Jersey 5-cent fares. So we have, but by the operation of the transfer system it is reduced, as far as the fare per ride goes, to 3.8 or 3.75 cents. That is the fare that every passenger who boards a car, whether for a cash ride or a transfer ride, pays us. A 5-cent fare, or this 3.8-cent fare, enables us to pay our operating expenses, pay a reasonable return upon the investment of capital, and, what is more important, obtain the necessary new capital for further development. In the eleven or twelve years of my administration, there has been invested between $30,000,000 and $40,000,000 in the development of the railway property alone. Under present conditions in Toledo, how long will it be before that sum of money is invested here?

Only yesterday I had the great privilege in the city of Newark of turning the first operation of a steam shovel on a new electric railway terminal which we are about to construct for the purpose of taking our cars off the congested centers of the streets. We approach this terminal along the one side by a subway a quarter of a mile long, and on the other side by an elevated line a quarter of a mile long. On the ground floor of this bulding will be a great concourse, like that of the Hudson Terminal, one flight down to the subway and one flight up to the elevated. When the terminal is done, we shall be able to double the cars now in use, and we hope to increase our business very materially. It will cost more than $5,000,000. We had no trouble to get the money because of the condition I have spoken of, but if you needed such a terminal in Toledo at this time, you would have a nice time getting any $5,000,000.

The answer to the whole proposition is that while there are peculiarities about this business, it is like every other business; it is governed by inexorable economic laws, which no amount of skullduggery or tomfoolery or political nonsense can overcome. Some people say I am blunt and tactless at times and undiplomatic. I am all through with trying to soft soap these things to a successful issue. I propose, for one, hereafter to stand up and be counted and let the people of any community in which I am interested know just what they are doing, not only to me, but to themselves.

The Franchise Question

I know it is hopeless for me to attempt to change the attitude of the Middle West, or perhaps the rest of the country, on the question of short term franchises, but I also know that the principle of short term franchise is all wrong. It is uneconomical and unsound. I do not argue for the old fashioned, unregulated, perpetual franchise, which allows properties to be exploited by a few men for the benefit of themselves. Now that regulation has come to stay, as it has in this country, these things are a thing of the past. The question of the length of franchise, from the standpoint of the municipality, is relatively unimportant, whereas to the company itself it is of vital importance. Some say a twenty year franchise is long enough, and they ask you to make a large capital investment or to retain your present capital investment, with a twenty year franchise, and let the future take care of itself. Suppose any of you leased a piece of property on any of these main streets, where the property values are high, for ten years, and only for that period, and you went ahead and put a large mercantile building upon it, costing $100,000. Would not any reasonably prudent man, if he had only a ten or twenty year lease on that property, charge off one-tenth or one-twentieth of the value of his property as he went along? If these short term franchises are to be granted without any hope in them beyond the limit of the day to which they are granted, then I say it is the duty of the company to amortize its investment. In such a case, who must pay for the amortization? The people who ride on the car. It becomes an operating expense, or a fixed charge, an expense akin to an operating expense. In other words, it is a short-sighted policy on the part of the municipalities to insist on short term franchises unless they want to put an undue burden on the present generation. The length of a franchise period becomes immaterial when it is assumed that there is a commission that will enforce good service and reasonable rates. These constantly recurring periods, such as occurred a few years ago in Chicago and Cleveland, and such as is now going on in Toledo and is about to burst wide open in Detroit, hurt the community. If this franchise question did not come to a head with such periodic frequency, but went on either indeterminately, or so that the amortization would be spread over a long period of years and not fall so heavily upon the present generation, it would be better for all concerned.

Maximum Demand Determination

And Its Relation to the Cost of Supply of Electrical Energy

By P. T. Davies, before the C.E.A. Convention

In the sale of power developed from hydro-electric plants, a short study will usually show that the basis of sale should be on a demand basis, and that the use of the demand has little effect on the cost of production.

Under present conditions it is found that the maximum demand of an individual consumer is the most important feature from the standpoint of cost of supply—the use of the demand only affecting the diversity factor of the supply system.

Diversity factor, which is the raison d'etre of the present day supply plant, is, however, a matter which should be considered in determining a demand, and the only method by which this can be taken into account is by choosing the method of determination with due regard to the possibility of coincidence of demand.

Before proceeding to discuss the question of determination, it should be noted that the question of maximum demand is of equal importance in the operation of a steam plant as in the case of a hydraulic plant, and it is becoming more generally the practice to make rates for power supplied from steam-generated supply stations of such a nature that a definite return per horse-power of maximum demand is guaranteed. In this connection it is interesting to peruse the report to the Committee on 'Gas, Oil and Electric Light," on the investigation of the Commonwealth Edison Company.

The following illustrative figures have been extracted from this report in order to show the small part which the actual production costs bear to the total cost of supplying electrical power. These figures have been chosen with particular regard to the railway and bulk supply customers, who have, naturally, very much better load factor than the rest of the customers and whose use of maximum demand and, therefore, operating cost per horse-power would be materially higher than that which would be apportioned to the average customer.

These figures show as follows:—Year 1911: 443,428,100 kilowatt hours sold for bulk supply. Production costs $1,579,712, of which, however, $213,759 does not depend upon kilowatt hour use, making $1,365,953 which can be traced to production costs, pure and simple. Transmission, commercial, general, and miscellaneous expense, $716,105.

In 1911 the kilowatt hours sold for lighting amounts to about 130,000,000, for power about 75,000,000, and for railway load 445,000,000. At the same time the connected loads show 190,000 kw. for lighting, 120,000 kw. for power, and 110,000 kw. for railway load, making a total railway and power load of 230,000 kw.

It will generally be admitted that the maximum demand of the railway and power load will be a higher proportion of the connected load than that of the lighting, and if we take the maximum demand of 40 per cent on the connected load for lighting, we will be taking a very liberal figure—40 per cent of 190,000 = 76,000 kw., which, deducted from the maximum load of 199,000 kw., the maximum load of the system, gives us a power load of 123,000 kw., or 62 per cent of the total load.

If we apportion 62 per cent of the fixed charges, including depreciation, to the power load, we shall not be putting on too heavy a charge, in view of the fact that approximately 80 per cent of the kilowatt hours sold are sold for railway and power use. While the report does not show the amount set aside for depreciation, we have, however, the following figures:—

Table No. 4—Expense including Depreciation	$10,647,052.00
Table No. 10—Expense excluding Depreciation	7,007,980.00
Difference = Depreciation	$ 3,639,072.00
Interest	1,563,774.00
Dividends	2,221,474.00
Total Fixed Charges	$ 7,424,320.00
62 per cent of this	$ 4,603,078.00
Add General Expense—62 per cent. of $716,105	443,985.10
As above, operating expenses were shown to be	1,365,953.00
Giving a total of	$ 6,413,016.10

Of which the fixed charges are 78.5 per cent., showing that on a steam-driven plant with a very high load factor the fixed charges are far and away the most important item in the cost of supplying the energy.

In order to investigate the proportion which the fixed charges bear to the operating charges in a hydraulic plant, the following figures have been taken as representative of a moderate sized hydro-electric development of medium head, operating at a distance of 30 miles from a main market for power:—

	Capital Cost per H.P.	Depreciation $ per H.P.	Interest at 5% $ per H.P
Cost of Hydraulic Development, including Dams and Power House, per h.p.	$70.00	2.10	3.50
Water Wheels and Electric Generating Plant, including Switchboard	30.00	3.00	1.50
Step-up and Step-down Transformers and necessary Oil Switches	5.00	.25	.25
Transmission Lines, including Right-of-way	15.00	.90	.75
Receiving Station	5.00	.25	.25
Switchboards for Local Distribution and Wiring	1.00	.05	.05
Regulators for Local Distribution and Wiring	3.50	.35	.17½
Cost of Service taken at an Average Distance of Two Miles from Receiving Station	10.00	.80	.50
Customers' Transformers and Individual Services	4.00	.40	.20
Totals	$143.50	$8.10	$7.17½

Interest at 5 per cent on Capital Cost of $143.50 per h.p.	$7.17
Depreciation per h.p.	8.10
Taxes and Incidental Fixed Charges on Meters, etc.	.50
Total Annual Fixed Charges per h.p. Installed	$15.77

The actual operating charges on a medium sized plant taken over a period of a year, taking into consideration a 25 per cent. steam reserve, runs as in Table 1.

Now, it is very obvious that few of the above operating charges themselves are affected by the running or not of the plant, and if we apportion 50 per cent to fixed charges and 50 per cent to running, we get

A total fixed charge of ... ... $18.97 per h.p.
And a running charge of ... ... 3.21 per h.p.

Table 1

MANUFACTURER.	
Wages of P. H. Employees	
Generating and Distributing:	
Oil and Waste	
Ice Expense	
Heating and Lighting	
Sundries	
Flashboards	$3.20 per h.p.
Steam Power Plant:	
Fuel	
Wages	
Oil and Waste	
Water	
Ash Handling	
Distribution:	
Poles and Lines	
Inspection and Testing	
Pole Rental	
Fire Patrol	$0.53 per h.p.
Moving Poles	
Labor on Connections	
Testing Meters	
Changing Transformers	
MAINTENANCE.	
Power House:	
Buildings	
Dams	
Crane	
Water Wheels and Equipment	
Dynamos	
Electrical Equipment	
Transmission Lines	
Crane	
Cables	
Conduits	
Distributing Stations:	$2.68 per h.p.
Crane	
Transformers	
Elec. Machinery	
Steam Station	
Engines	
Boilers	
Belts	
Pumps, etc.	
City Distribution:	
Poles and Lines—Subways and Conduits, Meters, Transformers, Tools and Machinery	
Total	$6.41 per h.p.

Or fixed charges = 86 per cent. of total expense.

Now, if the fixed charges are the basis of the expense of operating the plant, what factor in the use of power by a customer is the one which affects the proportion of the fixed charge which should be borne by such customer? Without doubt, it is primarily the amount of plant, transmission line, receiving station capacity and city lines capacity which is required for the supply of power to the consumer which cannot be used at the same time for the supply to other customers.

Diversity factor or the non-coincidence of consumer's demand is, as previously stated, the reason for the existence of power supply stations, as even the decreased capital cost of large units compared with small units, the decreased operating and engineering costs following the handling of large amounts of power, together with the fact that very best engineering talent can only be supported by the large plant, would not overcome the cost of running an individual plant which requires no transmission line or costly water-power development were it not for the fact that non-coincidence of consumer's demands enables the large plant to supply from one and a half to three times the sum of the individual demand of the consumer, whereas the individual plant must install sufficient capacity to take care of its maximum load.

In the determination of demand there are three methods at present in use, as follows:—

(1) Demand based on instantaneous peak.

(2) Demand based on lowest point of usage, during a stated interval.

(3) Average load during stated interval.

The first basis is, without doubt, a hardship on the consumer, and its use creates an apparently low schedule of rates for the attraction of consumers, which, however, only means that the consumer is billed on a high load at a low rate instead of at a good average load at a medium rate. Even if the price is kept at a reasonably low rate, the possibilities of instantaneous demands are always present, and, furthermore, an instantaneous demand is not necessarily a fair criterion of the amount of investment necessary to serve a customer.

The second method, although used in one or two instances, cannot be regarded as being a solution of the determination of maximum demand, as it is open to abuse—thus, a customer who may be paying upon the lowest usage during the highest 15-minute period per month, may have operations in his plant which are intermittent and do not last fifteen minutes. Furthermore, by prearranged methods it would be quite possible to arrange to defeat the ends of the contract by arranging to open the switch at any time when there is a possibility of a new 15-minute maximum being registered.

The third method is the one which is usually used, and it is the means used to obtain the demand by this method which will bear inquiry.

There are three points which it is intended to discuss:—

(1) Length of demand period.

(2) Number of demands to be taken.

(3) Whether a demand, once established, shall remain the billing basis for the balance of the contract unless exceeded.

A hydraulic plant has normally no overload capacity, while it is true that the possible output may vary from day to day and even during the day, and, further, that water storage may be available and be used in such a manner that the load factor of the plant can coincide with the load factor of the system and water be conserved; nevertheless, the output of water wheels has a definite limit, and it cannot be overloaded in the same manner as a steam plant.

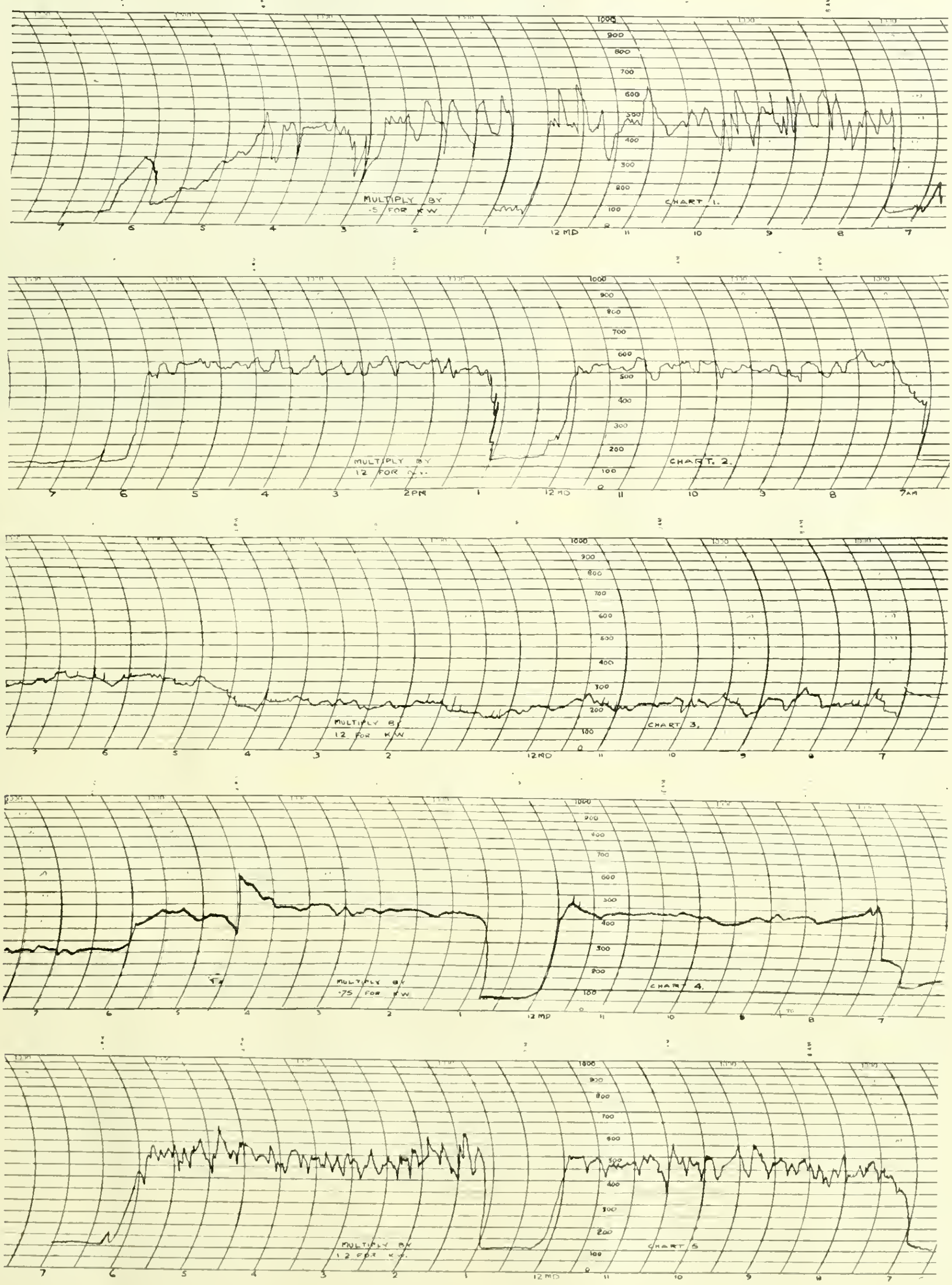
In order to obtain, however, a basis of working, it is necessary to assume that a short period of overload can be absorbed under normal operating conditions, and this period has been taken as two minutes.

In view of the fact that we can allow very little margin of overload on the generating plant, it is obvious that the length of the demand period must be chosen so that the possibility of coincidence of demands has a fair factor of safety in favor of the supply station.

The time of day when power loads reach their maxima is generally from 7 a.m. to mid-day and from 1 p.m. to 5 p.m. The figure of 5 p.m. may be questioned, but experience shows that nearly all industrial establishments show a drop in load after 5 p.m., due, no doubt, to the natural disinclination of workmen to start any fresh operation after this time, and also the prolonged preparation for home going is more the rule than the exception.

This gives us nine hours per day during which peak loads may coincide.

It will be conceded that a demand of less than five min-



Charts 1, 2, 3, 4 and 5

utes would be a hardship on any industrial establishment if taken as the billing basis for a month or more, and we may take a five-minute maximum average demand as the minimum period of time which could be considered reasonable

The chances of two equal 5-minute peaks overlapping for two minutes in nine hours is 67.5 to 1.

The chances of two 10-minute peaks overlapping two minutes in nine hours is 30 to 1.

The chances of two 15-minute peaks overlapping two minutes in nine huors is 19.3 to 1

The chances of two 20-minute peaks overlapping two minutes in nine hours is 14.2 to 1.

We have, however, 30 days during each month upon which equal daily demands on two systems may coincide, and this reduces the chances to the following:—

Two 5-min. peaks coinciding two mins. 2.25 to 1 against.

Two 10-min. peaks coinciding two mins. 1. to 1 against.

Two 15-min. peaks coinciding two mins. .643 to 1 against.

Two 20-min. peaks coinciding two mins. .44 to 1 against.

If we now consider a larger number of peaks than one, we obtain the following comparison:—

Two 5-minute peaks on each of two customers coinciding two minutes	1.15	to 1
Compare one 10-minute peak on each of two customers	1	to 1
Three 5-minute peaks on each of two customers coinciding three minutes	.75	to 1
Compare one 15-minute peak on each of two customers	.643	to 1
Four 5-minute peaks on each of two customers coinciding two minutes	.55	to 1
Compare one 20-minute peak on each of two customers	.474	to 1
Compare two 10-minute peaks on each of two customers	.5	to 1

These figures show mathematically that, presuming similar peaks occur each day, the chances of several five-minute peaks coinciding are less than the chances of prolonged demands equal in duration to the sum of the five-minute peaks coinciding.

The mathematical calculation of the possibility of coincidence offers a field that a short paper cannot investigate, and, in order to check conditions as obtaining, a random choice has been made of a number of graphic charts on industrial concerns, which occurred upon the same day—December 5th, 1913—and demands determined from them as shown on following pages.

It is unfortunate that charts having lower load factor and more pronounced peaks were not available, but the charts chosen offer a comparison, and further work can be done when better charts are available.

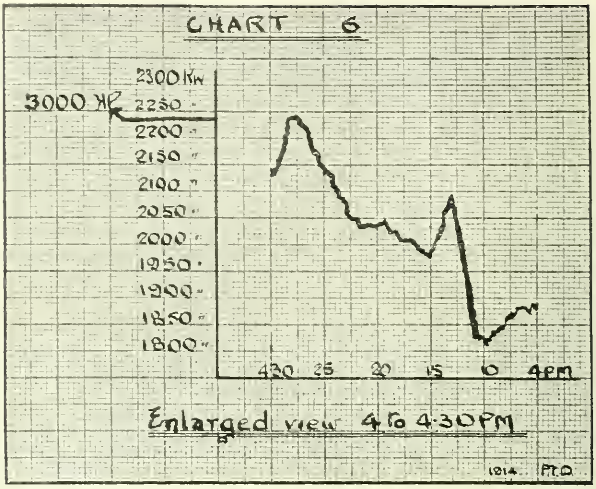


Chart 6.

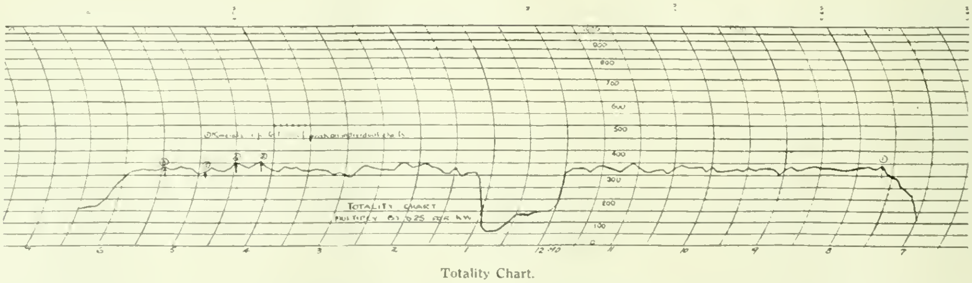
The five charts have also been combined into a totality curve, giving the diversity factor of the system, and offering a basis for the determination of the effect of the individual peak on the cost of supply.

PEAK LOADS

	One 5 min.	Two 5 min.	Three 5 min.	Four 5 min.	One 10 min.	Two 10 min.	One 15 min.	One 20 min.
Chart 1 ...	326	323	319	314	310	306	298	291
Chart 2 ...	940	932	924	920	916	910	902	900
Chart 3 ...	530	525	522	520	520	515	515	510
Chart 4 ...	560	540	530	520	540	520	530	520
Chart 5 ...	950	926	907	895	870	860	840	835
Sum ...	3,306	3,246	3,202	3,169	3,156	3,111	3,085	3,056
Figures from totality chart	3,940	2,880	2,830	2,800	2,880	2,800	2,830	2,800

Max. 2-min. peak equals 3,000 h.p. on totality chart.

While the totality chart may be one or two per cent. out at different points of the load, owing to the fact that the curves were taken from instruments that used paper with curved ordinates, special care has been taken to determine accurate results during the maximum loads, which appear as above for the totality chart and have been separately calculated from Chart 6.



Totality Chart.

These figures bear out the mathematical calculation

closely, and show nearly the same conincidence as was calculated above.

A point of interest is that the maximum 2-minute peak is only 56 h.p. short of the total of the 20-minute average peaks, thereby showing that there is little margin of safety in using 20-minute peaks as a basis of billing and little diversity factor between 20-minute demands.

In view of these results, the figure of the average of the two highest 5-minute average loads taken in the same day is suggested as a billing basis for any month.

Chart 6 is an enlarged view of the combined load between 4 and 4.30 in order to determine same as closely as possible.

The last question, as to whether a load, once established, shall remain the billing basis, is an interesting and debateable one. In making a rate for a particular demand, the investment necessary to serve that demand only is a factor which must be valued. Such investment depends upon the capacity of lines, apparatus, etc., which must be purchased, and these, again, depend upon the allowable margin of drop in voltage and overload capacity of transformers which is permissible.

The margin in voltage drop is decided by the fact that the choice of wire which can be used allows only a broad factor to be obtained.

The sizes of wire vary from each other by 20 to 25 per cent, and it is, therefore, evident that we can allow a 20 per cent variation of maximum demand without requiring more line capacity. Similarly, transformers are not generally obtainable in sizes varying from one another by less than from 15 to 20 per cent, and although there is a variation in the cost per kilowatt for transformers depending on the size, this variation would not have much effect within a 20 per cent limit. It is evident, therefore, that for the investment required to serve a customer as regards city equipment a 20 per cent variable is allowable, because this is the nearest choice that can be made.

With regard to the permissible variation allowable in generating plant and transmission line, it will be found that almost the same factor will apply—the transmission line again can only be chosen within the limit of standard gauge. The variable in plant unit compared with total plant installed in six supply plants serving a large electric system in Eastern Canada is as follows:—

Plant No. 1	8 units
Plant No. 2	12 units
Plant No. 3	3 units
Plant No. 4	5 units
Plant No. 5	3 units
Plant No. 6	12 units
Total	43 units

Average unit per plant 7—variable 14 per cent in plant unit.

It must be borne in mind, however, that the hydraulic development has to be almost wholly completed even if all units are not installed, and, therefore, the variable is only on the machinery and equipment, and not on dams and cost of property, water rights, etc.

Taking this into account, we get the total value of plant variable as follows:—

FIXED CHARGES

Consumer's Service	20% of	$1.30 =	$0.26
Transmission Line and Transformer	20% of	2.15 =	.43
Generating Plant	14% of	4.50 =	.63
Development, say	5% of	5.60 =	.28
			$1.60

Or, approximately, 10% of $15.77.

This figure of 10 per cent is suggested as the amount of variation which should be allowed from any established demand. Of course, individual plants differ considerably, and the best size of generating unit to install is a matter that has to be determined for each plant itself.

In conclusion, it should be stated that this paper has been particularly written with the idea of obtaining discussion on the various questions involved, as it is a consummation very much to be desired that a standard method of determining maximum demand and applying same be arrived at which will be fair to the consumer and be an adequate protection to the supply company.

Interruptions on L. D. Transmission Lines

Their Origin and Best Methods of Prevention

By P. Ackerman, before the C. E. A. Convention

Long distance transmission of, electrical energy has within the last decade, undergone marvellous changes both in the applied voltage and the distance of transmission. In the rapid development higher voltages have been chosen for the new systems and we now have systems with 150,000 volt operating voltage and transmission distances of 250 miles.

With the application of higher voltages, new operating difficulties have been experienced which are due, not only to the higher voltage, but also to the larger generating capacity existing in such high voltage systems. Progressive though the engineer has been in adopting higher voltages, yet the progress has been slow in regard to improving the reliability of operation of these systems. It is only within the last few years that the important possibilities for improvement have been realized. Now, however, strenuous efforts are being made to bring the reliability of long distance transmission to the standard of reliability of the important low voltage systems.

The object of this paper is to define the troubles affecting the operation of a transmission line and their causes, and to describe some of the problems relating to improving unfortunate factors of high voltage transmission.

The chief troubles, their cause and effect, on the operation of a transmission line under our climatic conditions, can be gathered approximately as follows:—

(1) Lightning Troubles form about 80/90 per cent of the total number of interruptions on a transmission system. The result of lightning interference is either a puncturing of an insulator, in which case a lengthy interruption generally follows if no spare line is available; or a flash-over, in which case the insulator may be seriously damaged by the power arc.

(2) Sleet and Wind cause troubles from wires getting within striking distance of each other, thus causing short circuits and total interruptions. Generally no damage is done to the cables and in this case only a momentary interruption will occur. However, occasionally the power arc may burn off the wires or cables, in the latter case causing an interruption of several hours if no spare lines are available.

(3) Birds and Other Outside Interferences, such as

wires being thrown against transmission wires, etc., generally cause a momentary interruption without damage to the line.

(4) Unexpected Insulator Failures, due to puncture of insulators without apparent cause, are usually due to the observed weakening of insulators after having been in service for some time.

(5) Short Circuits in Distributing System sometimes cause a momentary interruption to the transmission system but without any further damage to it. This is invariably due to a non-selective straight overload protection.

The means of eliminating the troubles causing these interruptions must be sought along two general lines.

(1) Improvements of the insulators must be made to prevent any possible puncture destruction or destruction by power arc and to eliminate the observed weakening of insulators on the line.

If these weaknesses are overcome the interruptions from insulator failures mentioned in item (4) of the list will be entirely eliminated, and the durations of interruptions from lightning (item 1) will be greatly reduced and with certain devices to be described later may be prevented.

(2) Improvements on relays and relay layouts must be made to obtain such selective action that the faulty part of the system is cut out without causing a total interruptation. This is necessary in case of troubles from sleet and wind, outside interferences or short circuits is the distributing system.

These two problems will be discussed more in detail in the succeeding pages.

Improvements in Insulators

It has been shown that lightning causes the most trouble to a transmission line and that the insulator must be considered the weakest spot Quite often a single defective insulator will put a line out of service for several hours.

These facts have been known for a long time and a great deal of investigation work has been carried on during the past few years to clear up many of the mysteries surrounding insulator failures, and although their design has been improved and many devices for protection against power arc destruction have been proposed, there has been very little improvement in the insulator body itself.

Some may be more fortunate than others, but there is probably not an operator of a high voltage transmission line who could not tell of insulators punctured during lightning storms, or failing quite unexpectedly with no apparent reason.

It has been stated that the insulator can be damaged from lightning either by puncture through the porcelain or by the power arc flashing over the insulator. A lightning discharge near the transmission line creates an excessive over-voltage of steep wave-front or high frequency. The excessive voltage is very often higher than the voltage the line insulator withstands and the result will be the breakdown of the insulator nearest the lightning discharge, the over-voltage thus finding release to ground. If one phase in a grounded system or two phases in an ungrounded system break down simultaneously, then a short circuit is produced between phases and an excess current will flow across the insulators which arced to ground and normally a total interruption is required to extinguish the arc across these insulators.

If the insulator requires a considerably lower voltage to flash-over through air than it takes to puncture straight through the smallest thickness of porcelain existing between live wire and pin, the lightning surge will flash around the insulator with the dynamic current of the system following and forming a heavy arc. If, however, the voltage required to puncture through the porcelain is smaller or about equal to the flash-over voltage, then puncture will occur—that is, a small hole will be pierced through the porcelain from live wire to pin and the power current will flow through and will generally destroy the insulator. Puncture of an insulator is the most serious condition, as it will put the line out until the fault has been located and the insulator replaced, which frequently requires several hours.

Danger of Cable Burn-Off

In designs where the line wire is directly supported on a porcelain head and where such head may have a tendency to puncture, the situation is aggravated by the danger that the cable may be burnt off. Some observations and tests made by the writer may be mentioned to show the seriousness of this condition.

On an ungrounded system a ground on one phase was noticed. About two minutes later the line was cut out, no short circuit had occured. Upon inspection a line wire was found burnt off and the insulator head was found to have a puncture hole right in the saddle where the line wire was resting. It seemed at first hardly believable that the charging current of 6 amperes of the line wire to ground could have burned a 4/0 line cable through within approximately two minutes; however, since no other explanation could be found, it was decided to demonstrate this action by a test.

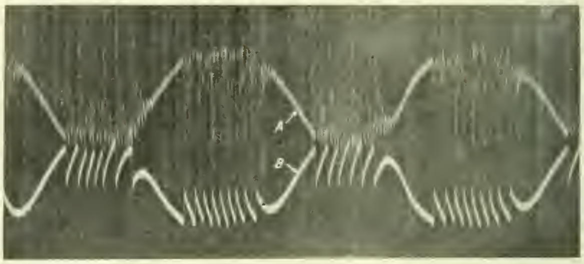


Fig. 1—Oscillogram on a testing transformer, showing discharge over insulator of 95,000 V. flash-over.
A—High tension voltage. B—Low tension voltage.

A punctured head was obtained and a line wire seated above the punctured hole. A 12,000-volt generator with a water rheostat in series with the puncture hole of the disc was adjusted to about 80 ampere current flow, this being the lowest possible adjustment. The discharge through the puncture hole had to be started by a thin fuse wire pushed through the puncture hole. With this adjustment the oil switch of the generator was closed in, starting the 80 ampere discharge through the puncture hole. Instantly a concentrated flame shot out of the puncture hole and within three seconds the 4/0 cable was burned in two.

Comparing the test result with the observed action on the line it will be noticed that in the test a current about 13 times larger than in the case of the ground on the line did the same destruction within about one-fortieth of the time and, therefore, the test may be considered a satisfactory explanation. The effect is evidently due to great concentration of energy at the point of puncture, since it must be understood that any puncture hole will, the instant when formed, be smaller than a needle hole and thus concentrate the whole discharge at this point.

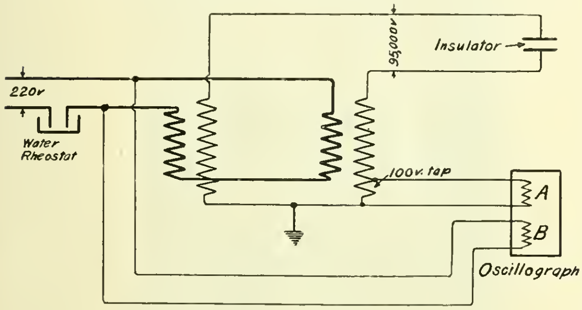
It will now be understoood why in case of an actual short circuit on a line, where not only 6 amperes, but possibly several thousand amperes may pass through the small puncture hole, the momentary destruction is enormous, and it may be easily understood that in such cases the punctured insulators or discs may actually burst apart and line cables seating on them burn off notwithstanding the fact that there may be instantaneous relay action. From this it may be concluded that line wires should not be supported directly

on porcelain unless one can be absolutely sure that the porcelain is non-puncturable. It is safer to have a design having the cable supported away from any point of possible puncture.

Aside from the serious trouble just mentioned, the puncturing of an insulator will tend to cause long interruptions unless replaced, since the puncture hole will form a short air path between live wire and ground that it may break down at normal operating voltage.

Routine Test Guaranteeing Porcelain of Even Electro-Static Quality

It has been previously mentioned that in order to obtain a non-puncturable insulator the puncture voltage must be considerably higher than the flash-over voltage of the insulator. The flash-over distance may be considered as a sort of safety valve for the porcelain—the lower it is set the better the porcelain will withstand any strain it is subjected to, since, it will bring relief before the breakdown voltage of the porcelain is reached. How high this ratio of puncture to flash-over should be, not to overstress the porcelain for the steepest wave front or the most severe high frequency, is not definitely known, but experience shows that it should be at least 1.5:1 and preferably 2:1.



DIAGRAM, SHOWING CONNECTIONS OF OSCILLOGRAPH TO TESTING TRANSFORMER

Fig. 2.

In the search for a commercially possible routine test which would assure an even product, a ratio of puncture to flash-over of at least 1.5:1, it was determined that a flash-over test of a sharp pronounced high frequency nature was considerably more severe on insulators, even if only on for a few seconds, than a test of any duration near but below flash-over point. Further, it was noticed that the longer a continuous sparking-over continued the more discs were punctured. These observations led to the suggestion that a certain relation existed between the duration of application of the high frequency spark-over and the ratio of puncture to flash-over. A comparative test was made on a large number of discs, subjecting the discs first to a two minute flash-over of absolute continuity and thereafter determining the puncture value of the discs which withstood the test by puncturing them under oil. The result was that all discs which withstood successfully the two minute flash-over test, had a puncture value which was 40 per cent higher than the flash-over voltage. This relation between time of application and minimum necessary ratio of puncture to flash-over may be different on different test sets, depending upon the characteristics of the whole test arrangement. In a general way, however, it may be said that the ratio will be increased as the short circuit current on the test transformer is choked down. This will be more clearly understood by studying the oscillogram of such spark-over. Fig. 1 shows the oscillogram of the high and low tension voltage of the testing transformer during discharge over an insulator. Fig. 2 gives the diagrammatic connections of the oscillograph to the test circuit. This oscillogram indicates clearly that the flash-over test is more severe than an ordinary test below flash-over, since in case of the flash-over test severe high frequency oscillations are obtained. An explanation of the oscillogram may be given as follows:—The high tension winding of the transformer has a certain electrostatic capacity: If now the momentary voltage impressed upon the insulator, gradually rising from zero, is reaching the flash-over point of the insulator, a short circuit will flow over the insulator. The current will be composed of two super-imposed currents, one being the low frequency current of the energizing power system, the other the transient discharge current of the short circuited electrostatic capacity of the transformer. The transient capacity current will rapidly diminish to zero in the form of a damped oscillation, and will, therefore, not be able to maintain the arc over the insulator when reaching zero point. The low frequency power current, however, would ordinarily be heavy enough to maintain the air broken down, although the voltage may have dropped to zero. Therefore, if the arc is to be extinguished after the transient discharge has occurred, it is essential that the power current be choked down to a very low value. This has been the case in the test shown on oscillogram of Fig. 1. The result was that after the first transient discharge of the capacity was completed, the arc was completely extinguished and allowed the potential to build up again and charge the whole electrostatic capacity of the transformer winding and the insulator. The instant the flash-over voltage was reached again the insulator arced over again and repeated the oscillatory condenser discharge, this phenomena being repeated on each half cycle until a point was reached on the fundamental half wave which was not high enough to flash-over the insulator and starting again when the flash-over voltage is reached on the next half wave.

The number of discharges per half cycle are governed largely by the test arrangement, but can be forced by keeping up the voltage on the low tension side. This oscillogram and the mentioned test results indicate clearly the way to a routine test which should guarantee an electrostatically even, sound porcelain. This can be assured by specifying a flash-over test of absolute continuity of several minutes' duration

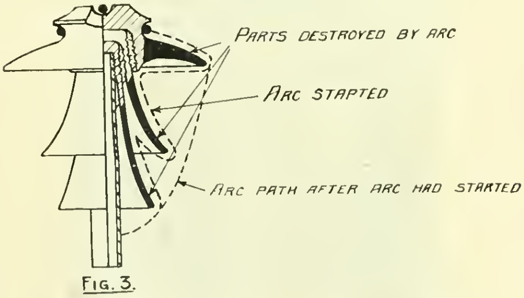


FIG. 3.

with a test arrangement having the power choked down. This is normally indicated by a clean pronounced, sharp crackling high frequency discharge.

Weakening of Porcelain While in Operation on Line

One problem, however, remains to be solved even after the means are available for procuring an insulator withstanding puncture when first put up on the line. It has been the experience of most power companies that a slow weakening of the insulators occurs after having been in service for some years, and that insulators which may have stood any kind of flash-over may, after some time, puncture even at normal voltage. No definite answer has been given as yet to this observed weakening and no absolute remedy deter-

mined. However, we can hope that this matter may be cleared up in the near future, since it has been receiving the attention of both manufacturers and power companies.

Destruction of Insulators From Power Arc

With the insulators made non-puncturable, a lightning discharge will flash-over the insulator and cause an excessive

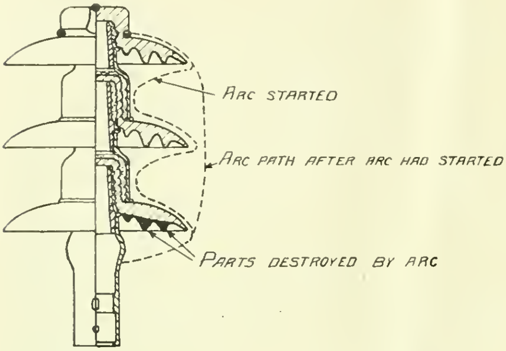


FIG. 4.

dynamic current to follow, developing a so-called power arc with its attendant heat, endangering the porcelain.

The effect of such a flash-over may, under certain conditions, be as destructive as a breakdown due to puncture. There are, however, more possibilities for safeguarding against this action.

Some investigations made by the writer may give a clearer understanding of the points which must be taken into

Fig. 5—Insulator destroyed by 500 amperes power-arc of five seconds' duration.

consideration in determining a means for preventing power arc destruction.

To determine the resistance of certain insulators against heat destruction from power arcs, some tests were made on two types of insulators as shown in Figs. 3 and 4, both being in use on a 60,000 volt line. A 10,000 kw. generator was used to provide a discharge over the insulator at a current rate of 300 to 500 amperes. The arc was started by means of a very thin fuse.

Figs. 5 and 6 show the destruction obtained in various tests. The pictures are self-explanatory, readily showing the destructive effects of a power arc of several thousand amperes on the line even though the arc be interrupted by instantantous relays. Comparing the results with the two different types of insulators, a conclusion may be drawn in regard to the general principles which have to be considered in the design of insulators to better resist destruction from power arc.

Fig. 3 is one of the old type insulators with very long petticoats of thin wall-thickness. The hot vapours of the arc are caught in the deep pockets, resulting in the breaking up of the petticoats; the small wall-thickness reduces the resistance to heat destruction.

Fig. 4 represents a new type of insulator built according to the general principle of the suspension insulator. In regard to resistance against power arc destruction, it has the advantageous features, however, of having heavier discs and a shape allowing the vapours greater opportunity to escape. The effect of these features can be noticed by the small destruction indicated in Fig. 4 and Fig. 6, where the

Fig. 6—Insulator destroyed by 400 amperes power arc of five seconds' duration.
1—Three-petticoat insulator.
4—Bottom disc of disc type insulator. See Fig. 4.

corrugation of the bottom disc only broke off without affecting the insulating quality of the whole insulator.

Recognizing the impossibility of preventing flashing-over over the insulator from lightning surges, and on the other hand recognizing the destructive action of the power arc, a device was considered which would deflect the arc away from the insulator before harm could be done to same. Several such devices are known and some have been in use for several years. However, most of them are so designed that the arc will generally stay at one point on the cable or tie-wire and thus fuse them off. The horn as shown in Fig. 7, therefore, was designed with the object of producing a natural tendency for the arc to follow the line wire and not to rest at any point. The result was very effective, as is indicated in Fig. 8. Arcs were started by a thin fuse on different sides of the insulator and with wind action from different directions. About a dozen discharges were made in still air as well as in wind, and all that could be noticed on the line cable or tie wire were very light surface spots, the arc being carried with great speed along the line cable. It was particularly interesting to note the easy movement of the power arc and its great sensitiveness to the slightest air current. This horn was never tried out in practice, not be-

cause its practicability was questioned, but because another apparatus was then decided on which made any need of an insulator arc protector unnecessary. Some mention may be made of this latter development.

All the features thus far mentioned have tended to improve and protect the insulator in order to prevent serious long interruptions to transmission systems; however, none of them will prevent momentary interruptions. Nicholson's arc extinguisher goes one step further and attempts to avoid even the interruption. It is based on the following principle: The instant an arc-over and the resulting short circuit occurs at any point on the line an overload relay located at the generating station will close an artificial short circuit through high tension fuses; this metallic fuse circuit will draw all the current away from the insulator, thus allowing the air around the insulator to establish new insulation. Meanwhile the fuse will blow and rupture the artificial short circuit. This whole process completes its cycle within a fraction of a second, and the result is that the voltage of the system will merely be disturbed for a short time and in a manner similar to a short circuit separating itself selectively from the main system.

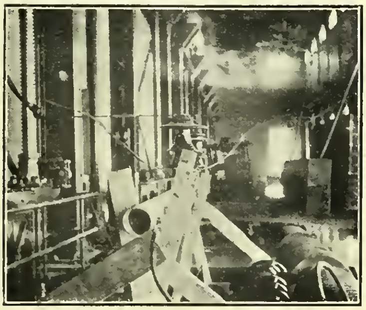


Fig. 7—Horn arrangement used as power-arc deflector.

Synchronous machines may drop out of step if of low synchronizing power; however, lighting and induction motor power will observe a momentary flicker only. The device is decidedly a lightning protection, while for wires swinging together, or for shorts due to outside interference, it will probably not be effective, since the fuse will blow too quickly and allow the arc at the point of trouble to re-establish again; however, since lightning troubles are by far the most numerous ones, we can be assured that this new method of keeping uninterrupted service over a long distance transmission line has considerable value. The first requirement for its success, however, is the absolute non-puncturability of the insulator.

In the foregoing mention is made of the characteristics of an insulator to reduce line interruption to the shortest possible time, and a device has been described which will prevent interruptions in case of insulator flash-over if the insulator has the proper characteristics of non-puncturability and non-ageing.

From the list of interruptions it can be noticed that with such improvements hope can be entertained of safeguarding against 80 to 90 per cent of our line interruptions.

Selective Relay Protection

Interruptions from sleet and wind, outside interferences, or short circuits in the distributing system are of such a nature that their prevention must be obtained by a proper selective relay protection, cutting out the faulty part only, without interrupting the main system.

The relay problem is very complex and can only be worked out with full knowledge of a system. Its importance has been recognized only within the last few years and it is only lately that a marked forward step has been made. The design of a relay layout is so largely depending upon the nature of each system that it is difficult to draw up any general rules, and for this reason only a few essentials are discussed.

Selective Straight Overload Protection

Fig. 9 represents the single wire diagram of a simple transmission system. The purpose of selective straight overload protection is to safeguard against total interruptions due to local troubles in the distributing system.

Assume, for instance, that a short circuit in one of the local distributing feeders could be cut off the main system by its own feeder switch without interrupting the whole sub-station, or, again, that a trouble in one of the sub stations might clear itself from the main system without interrupting the main system.

Fig. 8—Power-arc started over insulator and deflected by horn.

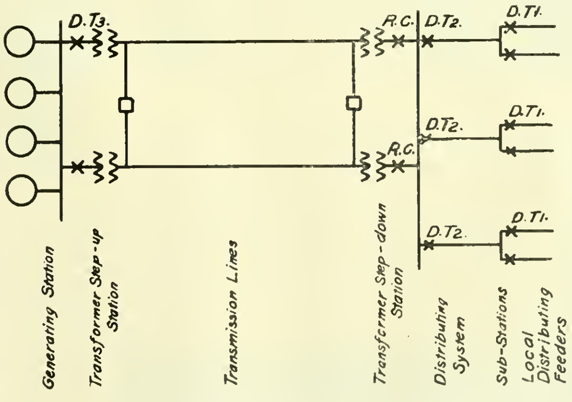


Fig. 9. — SINGLE WIRE DIAGRAM OF SIMPLE TRANSMISSION SYSTEM

This protection requires such characteristics of the relays that they will open the switch nearest to the short circuit before any switch nearer the generating station can open.

Until a few years ago this selective action was attempted generally by inverse time overload relays; devices were

set to trip at a certain overload current within a certain number of seconds; the characteristic of those relays was that the greater the short circuit current the shorter the time element became. The decrease in the time element, however, was so rapid that at a current flow of about two times the current setting—that is, the current at which the relay started to actuate—the action of the relay became practically instantaneous. The result was that not infrequently, due to a heavy short in one of the distributing feeders, where the excess current in the main system reached abnormal value, not only the respective feeder switch tripped, but also all of the switches back to the generating station, thus causing a total interruption. It was attempted to obtain selective action by setting the local distributing feeders for three seconds, the sub-station feeders for six seconds and possibly the lines at the generating station end for nine seconds, but with a heavy short circuit passing through all three settings were practically instantaneous and accordingly all switches tripped simultaneously. From this it will be understood that the first requirement to obtain a selective overload protection is a definite time characteristic for the relay on heavy short circuits—that is, it will require a certain definite time to trip the switch, no matter how heavy the short circuit current may be. With such a relay characteristic the local distributing feeders may be set with a certain time element D.T. 1, the sub-station feeders with D.T. 2, and the generating station switches with D.T. 3, (1) indicating the shortest time element, (3) the longest one, and having such intervals between the three switches that for the heaviest short circuits the switch nearest the short circuit has time to cut the short off before te next switch is actuated. In addition to this first necessary characteristic of the selective overload relay, two other vital characteristics are accuracy and reliability, otherwise the wrong switches may act and may thus impair the selectiveness. The higher the accuracy and reliability the closer successive switches can be set.

So-called definite time relays have been on the market for a number of years, but it is only recently that relays have been devised which combine all three necessary characteristics mentioned above, and it is for these reasons that it is only lately that successful selective, straight overload protection has been obtained.

Selective Opening of a Faulty Main Line

This problem is extremely difficult and has thus far not been solved satisfactorily. Present practice is to provide reverse energy relays at the distributing ends of the lines which are supposed to trip the instant the energy flow into the line reverses. Such reversal of energy always occurs on a faulty line on the far end, since current will feed through the good line and the sub-station at the far end back into the faulty line. These reverse energy relays are invariably built on a principle of such interaction between a potential and a current coil that with energy flow in the normal direction the relay contacts are kept open, while upon reversal of energy flow the relay contacts will close. These relays will usually be very accurate on normal voltage. However, on very low voltages some of them will not act at all, like a wattmeter with the potential coil disconnected, or others will act on straight overload. Since, in the case of a short circuit on a line the potential may drop almost to zero, it will readily be understood that relays of such characteristics will lose their selective reverse current feature, and it is quite common experience that their selective action is so unreliable that they cause total interruptions. This is particularly the case where the reverse current protection is put on lines which are tied together on the high tension side, since the short circuit current will then pass from one line to the other through the high tension bus, so that the low tension voltage from which source of relay is invariably energized will drop to zero.

The selective action of the reserve energy relay can be improved where the conditions permit operation of the two lines with the high tension side sectionalized, thus forcing a short circuit from one line into the other through the transformers and the low tension bus. This will have a tendency to keep some voltage on the low tension bus. However, even with these operating conditions, selective action of reverse energy relays can only be obtained when a relay will trip on very low voltage and power factor; and further, the impedance of the step-down transformers must be comparatively large to maintain sufficient voltage for energizing the relays. Unsatisfactory as this reverse energy relay has proven in the past, no better solution has yet been proposed as far as the protection of two parallel lines is concerned.

The Merz-Price system, which is successfully applied for cable and transformer protection and short distance overhead distribution, is on long distance transmission lines meeting with considerable technical difficulties. Further, it would be rather expensive, since pilot wires would have to be strung between the two ends of the line.

Selective protection of three or more parallel lines can be obtained by taking advantage of the fact that, whenever a short occurs in one line, the current balance in the respective phases of all parallel lines becomes disturbed. Schemes along this line may probably find some application in the future. They will be rather complicated in the wiring layout, as they will require interconnections between the current transformers of the parallel lines; but they will undoubtedly prove very effective, since the troublesome potential element is eliminated so that the heavier the short circuit the more positive the action of the relay.

From these notes on relays it will be observed that a large field for improvement is still open and considerable development is necessary before suitable relay protection for troubles on transmission lines by selective action is obtained.

In conclusion, it may be said that successful efforts are being made to improve the reliability of operation of long distance transmission lines and that hope can be entertained that the insulator problem will be solved at least to such a point that the chief causes of present transmission line troubles will be eliminated, and that with some further development in relays such selective action may be obtained that total interruptions will be safeguarded against.

Personal

Mr. J. B. Rannie, who has been connected with the B. C. Electric Railway Company in connection with its Vancouver city service for nearly 25 years has severed his connection with the company. Mr. Rannie's career with the company dates from September, 1889. His first work was on the reconstruction of some cars which had been purchased with the idea of the street railway being operated with horses, later plans providing for operation by electric current. He then served as motorman and conductor on the city lines, finally chosing the front platform as his permanent position. In Mr. Rannie's early days with the company, the Vancouver city lines consisted of a main line about two miles in length and a short spur line of half a mile. During his service with the company he has seen the Vancouver city lines gradually extend until now they cover 95.26 miles of single track. After serving as motorman for a number of years Mr. Rannie was in 1900 appointed traffic superintendent of the Vancouver lines. This post he filled until 1911 when he was appointed traffic agent in connection with the Vancouver lines, a position which he occupied up to the date of his resignation. Mr. Rannie will leave the field of electric railway activity, having purchased a small ranch in the vicinity of Chilliwack, B.C., where he will engage in agricultural pursuits.

Illumination

Hamilton's Underground Street-Lighting System

An order made in 1912 requiring all wires in the center of the city of Hamilton (except trolley-wires) to be run under ground, made an underground system of street-lighting necessary; and in 1913, the contract for laying conduits under seven miles of streets was awarded to G. M. Gest, of Montreal, Mr. E. I. Sifton being employed as consulting engineer. The actual work was begun early in September, 1913, and progressed rapidly. The various telegraph and electric companies use the same trench but different conduits and manholes, as shown in a descriptive article which appeared in the Electrical News of April 15 last.

The primary cable for street-lighting is run through three and one-half inch single clay conduits; two-inch fiber conduit, laid on the top of the main runs, is used for the

Fig. 1—Erecting standards, Hamilton.

secondary cable. The cable is made by the Standard Underground Cable Company, Hamilton. For the primary circuits, paper insulated, lead covered cable is used, while for the secondary circuits it is No. 6 rubber insulated, lead covered.

There are four 2200 volt primary circuits, with a total load of 200 kw. The three outlying circuits are single phase alternating, and the central circuit is three phase. The feeder transformers, in the manholes, which are the subway type, 220-110/220 volt, and from 3 to 10 kw. in size, were supplied by the Canadian General Electric Company. The secondary circuits are 110/220 volt, with grounded neutral. The lead sheath of the cable is used for the neutral and is grounded to the water pipes at each manhole. Between the last two lights in each circuit the cable has only one conductor, while the rest of the cable has two conductors.

Four hundred cast iron standards, fourteen feet high and weighing six hundred pounds each, are placed from 100 to 200 feet apart on both sides of the streets. These standards are made by the Brown, Boggs Company, Limited, of

Fig. 2

Fig. 3

Hamilton; they were carted about two miles and erected at the rate of thirty-five per day by the Department's motor truck, which also erected the seven thousand concrete poles used in the overhead districts. Fig. 1 shows the truck at work, and Fig. 2 the standard and fixture erected. The standards are bolted to a concrete base and are then plumbed and grouted. A door in the base of the standard affords means of access to the fuse, etc.

The fixtures were made by the Tallman Brass and Metal Company, Hamilton. One of the unique features of

Fig. 4

Fig. 5

the fixture is the way in which it opens to clean the glassware or renew the lamps, Fig. 3. The glassware is a Jefferson Moonstone glass. Ventilation is well provided for, the air inlet being between the fixture and standard and the outlet between the canopy and top of the fixture, which are of spun copper. During the ventilation tests, the maximum temperature within the fixture never rose above 260

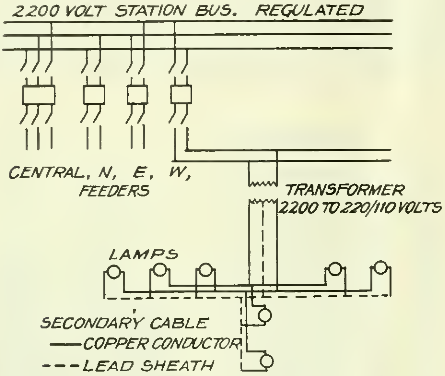


Fig. 6—Hughson Street Sub-station.

deg. F. Figs. 4 and 5 show the fixture assembled and dissembled.

The lamp used throughout the underground district is a nitrogen-filled, 500 watt, 110 volt, Laco-Philips tungsten, connected in multiple. Each lamp is fed by a No. 14 insulated copper wire, connected through a fuse at the base of the standard to the cable and a bare wire directly connected to the lead sheath of the cable.

It was also decided to install thirty-three standards on that part of York Street not included in the underground district, and a different system of construction was adopted. Inch and a quarter galvanized iron pipe is used instead of conduits, and is laid about one foot below the surface of the road, or, where possible, under the strip of grass between the sidewalk and the curb. This pipe was driven under the street-car crossings, and was laid at a much lower cost than that of laying the conduits. The lamps are placed 150 feet apart alternately on each side of the street. The first eight lights are fed from the last underground transformer, while the others are fed from the most convenient overhead lines on the adjoining streets. Tests were made to ascertain the voltage loss due to induction, and it was found that the lead sheath would carry nearly enough return current to neutralize this induction, the voltage drop being reduced to one-half volt per hundred feet. This loss was so slight that it was not deemed worth the expense of an extra conductor in the cable to balance the current and thus to eliminate it entirely.

The transformer equipment at the Hughson Street substation was described in a former issue. The current, after being transformed from 13,200 to 2,200 volts, is passed through C. G. E. induction-type voltage regulators and oil switches. The arrangement of the switches is very simple and is shown in the wiring diagram, Fig. 6.

The photographs of King Street at night, Figs. 7 and 8, show the superiority of the new system over the old. The new system was inaugurated on July 1 last, less than ten months after the beginning of the construction work.

Fig. 7 Tungsten Clusters formerly used.

Fig. 8—New Nitrogen units, Hamilton, Ont.

Trade Publications

Direct Current Motors—Bulletin No. 119, issued by the Robbins & Myers Company, Springfield, illustrating and describing their printing press and linotype d.c. motors.

Indirect Fixtures—The National X-Ray Reflector Company have issued a number of data sheets illustrating their indirect fixtures as applicable to the nitrogen lamp.

Meters—Bulletin No. 46291 issued by the Canadian General Electric Company describing and illustrating portable test meters, type IB-5 for alternating current circuits.

Corliss Engines—Bulletin No. 1529, issued by the Canadian Allis-Chalmers, Limited, illustrating and describing the more important features in their heavy duty Corliss engines.

Sewing Machine Motors—Bulletin No. 117 issued by the Robbins & Myers Company, Springfield, illustrating and describing the type F direct current factory sewing machine motors.

Ventilation of Engine Room—Pamphlet issued by the Canadian General Electric Company on the subject of "Ventilation of Steam Turbine Engine Rooms," being a reprint from The General Electric Review.

Linotype Pots—Publication No. 1531 issued by the Westinghouse Electric & Manufacturing Company, describing and illustrating Westinghouse Wicker type Electric Linotype Pots. The same company have issued descriptive leaflet number 3723 on Baldwin-Westinghouse Electric Industrial Locomotives, and electric leaflet 103, describing a number of catchy window displays which would be valuable to central stations.

Aluminium Cable—The British Aluminium Company have issued a very handsome illustrated book entitled "Power, Its Economical Distribution," and descriptive, chiefly, of aluminium insulated cables. The illustrations are unusually good and the information contained covers very thoroughly the characteristics of aluminium cable as well as its manufacture and installation; in fact, the booklet may be considered a treatise on the subject of aluminium cables.

Travelling Cranes—Bulletin B7 issued by the Herbert Morris Crane & Hoist Company, Limited, illustrating and describing their type S2 hand-operated travelling cranes.

Metal Moulding—A handbook on "National" metal moulding, issued by the Canadian General Electric Company, illustrating and describing the various "National" mouldings and fittings.

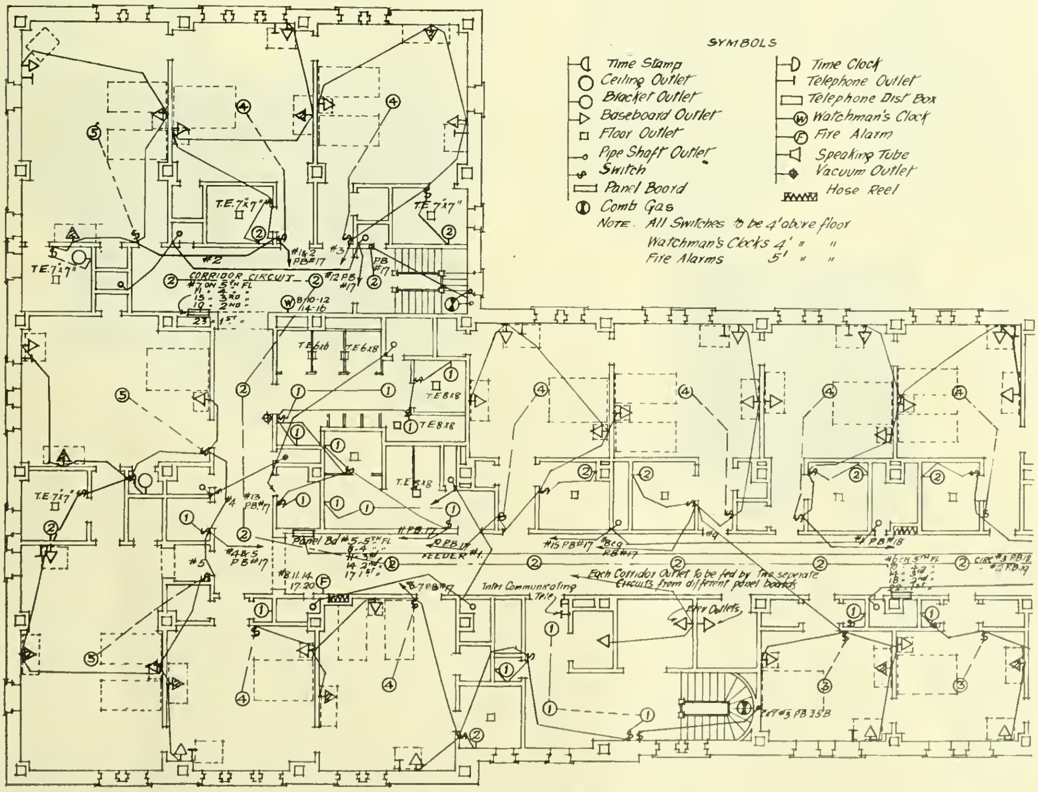
The Dealer and Contractor

The Wiring of Large Public Buildings

No class of building is receiving more attention at the present time as to the electrical installation than our large hotels. An excellent example of this is the Hotel Macdonald, Edmonton, one of the chain of fine hostelries the Grand Trunk Pacific Railway Company are installing across Canada. This hotel, in common with the Fort Garry at Winnipeg and the Chateau Laurier at Ottawa boasts as complete an electrical installation as can be found anywhere on the continent. The architects of the building, now nearing completion, are Messrs. Ross & Macdonald, Montreal; the general contractors are the Canadian Stewart Company, Montreal. The electrical equipment is being installed by the L. K. Comstock Company.

In accordance with the best practice no wall lights have been installed. These have long proven unsatisfactory both on account of the fact that they generally render a re-arrangement of the furniture impossible and also of the fact that they do not provide a general illumination. Prejudice in their favor, on account of their decorative effect, has died hard, however, and it is only within the last couple of years that the comparative uselessness of wall lights as a means of illuminating a room has been recognized.

The Hotel Macdonald is following the most approved practice and installing a centre ceiling outlet in each room with at least three baseboard outlets. This means one base outlet for a writing desk, one for the dresser and one for a reading lamp beside each bed. These baseboard receptacles also facilitate the use of all sorts of modern electrical appliances such as curling tongs, electric irons, small electric heaters, etc., all of which add to the comfort and convenience of the guests. Further, each room is equipped with two



Part of typical floor plan of Hotel Macdonald, Edmonton, Alta.

circuits so that in case of trouble on one circuit the guest is not placed at the inconvenience of being without illumination. Each bedroom floor is supplied from three panel boards which lead direct from the main switchboard thereby insuring a portion of the general illumination in each floor under any emergency except an entire break-down of the generating plant in the basement and at the same time of the local municipal lighting system.

The laundry and culinary department are equipped with the latest modern electrically operated apparatus. Electric elevators are installed and a complete electrically-driven ventilating system. The laundry machinery is, of course, of the most recent design and the units are driven, wherever possible, by individual motors.

The lighting is supplied from a 110/220 volt, three-wire, direct-current system. Power is supplied at 250 volts direct-current.

The hotel is supplied with its own generating plant consisting of Goldie & McCulloch engines and Triumph Electric Company (Cincinnati) generators. In addition to the private plant the lines of the Edmonton municipal plant have been extended into the hotel as insurance against break-down in the private plant.

The wiring is in conduit throughout, the material being supplied by the Conduits Company, Limited.

In addition to the features already mentioned a number of floor outlets have been installed; also a time clock system, a telephone system, a fire alarm system, and a vacuum cleaning system. We reproduce herewith a portion of a typical floor plan. The portion reproduced represents perhaps one-quarter of one of the five floors.

New Type Radiator

The Canadian General Electric Company are offering a new type radiator, as illustrated herewith. Type A-26, single heat and Type A-51, three heat, have capacities ranging from 1,200 watts to 2,400 watts. Type A-47, similar in appearance but somewhat larger, has capacities ranging from 3 to 5 kw. These heaters consist of a rectangular iron frame, having porcelain coil supports at the top and bottom. Over these supports is strung the heating element, which consists of 3/8-in. diameter coils of resistance wire. Castings are made of

Wellsville blue steel. The cast iron top and base of the types A-26 and A-51 have full nickel finish, while the top and base of the A-47 have black Japan finish.

A Waverley electric 1,000-lb. delivery wagon recently made a trip from Buffalo to Lockport and back, 52 miles in all, bring a 900-lb. load on the return trip in a total running time of three hours and a half. The current used on the round trip was 105 ampere hours, which, at regular rates in Buffalo, amounted to less than 10 cts. On another occasion the same car made the same round trip and about 18 miles of additional travel, or 70 miles in all, on 130 ampere hours, all at highest speed, the battery having a capacity of 150 ampere hours.

Adjustable Panel Boards

The Trumbull Electric Manufacturing Company have issued a folder drawing attention to the adjustable features of their panel boards, boxes, and cabinets. The box is first installed then corner irons as shown in Fig. 1 are securely

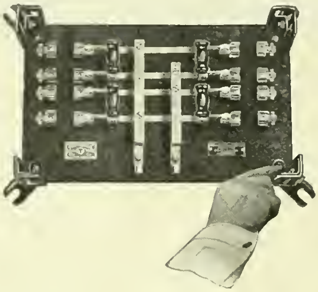


Fig. 1.

Fig. 2

fastened to the base of the panel. Fig. 2 shows an enlarged view of the corner iron from which it will be seen that an air space is provided between the panel and the box. The third operation is to secure the panel in the box and connect up the mains and circuit wires, after which the slate frames are slipped in place as shown in Fig. 3. The practical elec-

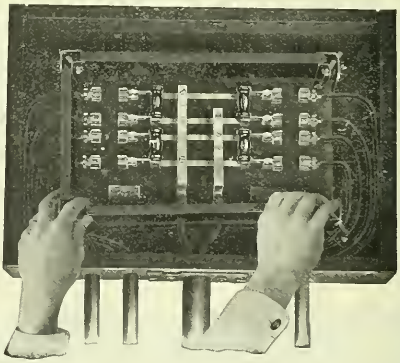


Fig. 3.

trician will appreciate the advantage of being able to make his wiring connections before putting in these walls. This is accomplished by slotting the bottom of the slate frames instead of boring holes for the wires to pass through as is ordinarily done. Aside from the convenience a great deal of time is saved. It is also claimed that with the corner irons as shown the panel is adjustable in any position practically independent of the position of the box. Another feature is the patented hole closer which can be so adjusted that you can get a conduit hole 3/4-in., 7/8-in., 1-in., 1 1/4-in., 1 1/2-in., or you can close the hole entirely by placing blank ends together.

Obituary

After an illness of several months, Mr. James D. Wood, assistant tariff chief of the G. N. W. Telegraph Company, died in Montreal on July 4.

General Devices and Fittings Company

A new company was recently incorporated under the name of the General Devices & Fittings Company for the manufacture of high grade and original power, light and railway plant appliances and for sub-station and transmission service. These fittings and devices will consist of high tension and low tension appliances such as out-door high tension disconnection switches for high tension devices with a voltage range from 600 to 200,000 volts. This includes busbar apparatus of any capacity and any voltage required.

The company will also manufacture bus-tie, bus-sectionalizing, transformer, feeder and generation disconnecting switches of all capacities and for all types of mounting. Indeed, the manufactured products will include large plant equipments complete with the exception of moving apparatus, transformers, instruments and oil switches.

The head office and factory of the company will be located in Chicago though the personnel is well known to the Canadian electrical trade. Mr. E. O. Sessions, president, was formerly with the Thompson-Houston Electric Company and later with the Stanley-G. I. Electric & Manufacturing Company and the General Electric Company and more recently formed a partnership to carry on consulting engineering work. He is a Fellow of the American Institute of Electrical Engineers, a Member of the American Society of Mechanical Engineers, an Associate of the American Society of Civil Engineers and a Member of the Illuminating Engineering Society. Mr. A. V. Fonger, treasurer, was formerly with the General Electric Company and later with the Electrical Engineers Equipment Company. He is an Associate of the Association of Iron & Steel Electrical Engineers. Mr. J. M. Van Splunter, secretary, was formerly associated with the engineering department of Sargent & Lundy, consulting engineers, and later as construction engineer for the Stanley-G. I. Electric & Manufacturing Company. More recently he was connected with the sales organization of the General Electric Company. The General Devices & Fittings Company will be represented in Western Canada by the Benjamin Richardson Company of Winnipeg.

Edson O. Sessions.

A. D. Fonger.

J. M. Van Splunter.

Canadian Steel Products Company, Limited

The Canadian Steel Products Company, 227-229 Wellington Street, Montreal, announce that they have completed the equipping of their factory for the manufacture of sheet steel, flush and service cabinets for switches, cut-outs and panel boards. The factory will be under the general managership of Mr. S. A. Ungerleider, who has had extensive experience in the United States. The machinery and tools are all of the most modern and improved type.

The boxes are made in one piece of sheet steel, formed and bent in large presses, and the covers are so fitted that they render the boxes dust proof and for most uses practically water proof. The doors and trims can be finished to match any shade of woodwork though the standard finish is baked black Japan. The absence of wood fronts on distributing cabinets is an excellent idea as it insures a fire-proof installation in every particular.

The Canadian Steel Products Company will also manufacture time switches, sheet steel shop equipment, steel shelving and lockers, portable garages and other sheet steel and electrical specialties.

A New Flush Receptacle

The Hart & Hegeman Company, of Hartford, Conn., have recently placed on the market a new flush receptacle which is finding favor with the trade. This receptacle is unusually easy to wire up as it takes no time at all to hook up the plug. The base is very compact in size, being only 1¼ inches deep and 1¼ inches wide. The contact sleeves engage the plug fingers over a large conducting area, and while they hold them snugly a slight pull will release the plug. The contacts are sunken and separated by a wall of porcelain, and accessible only through the narrow porcelain tubes; so dust cannot be swept into them, and it would be very hard for a child to short-circuit the device. Because the contacts are separated by this wall of porcelain the current cannot jump across, and the narrow porcelain tubes through which the plug fingers are withdrawn have a choking effect upon the arc. Moreover, these porcelain tubes, or sleeves, protrude up into the countersunk holes of the plate, so that it is impossible to draw the arc up to the surface of the plate, and then to have a short-circuit through the plate. This new receptacle is being handled by the Canadian General Electric Company.

New flush type receptacle.

Nitrogen Lamps in the West

The City of Kelowna, B.C., has ordered a complete equipment of Nitrogen Filled Tungsten Lamps varying from eighty to three hundred and fifty candle-power and will light the streets with fixtures spaced one hundred feet apart except in the extreme outlying districts where a spacing of two hundred feet has been adopted. The present arc system is being installed in the business district and the amount of illumina- entirely superseded. The larger candle-power units will be tion will decrease gradually to the outskirts. Claude R. Yuill, successor to Mather, Yuill & Company, Limited, is consulting engineer for the city.

The 1914 Convention of the American Electric Railway Association will be held at Atlantic City on October 12-16.

Current News and Notes

Alberton,, N.B.

The town of Alberton, N.B., have just awarded a contract to the Canadian Fairbanks-Morse Company, St. John, N.B., for complete electric light outfit, consisting of dynamo, switchboard and the necessary transmission material for their new town lighting system. The dynamo will be driven by water power.

Baie d'Urfe, Que.

The council of Baie d'Urfe are installing an arc light system the contract for which has been let to Mr. W. G. H. Cam. This is a continuation of the Beaconsfield system, also installed by Mr. Cam. Energy is supplied from the Beaconsfield sub-station of the Montreal Light, Heat & Power Company. When the Baie d'Urfe installation is finished it will mean the completion of the lake shore lighting system as far as St. Anne de Bellevue where a lighting system is already in operation.

Bedford, Que.

The different power companies in Montreal are being communicated with having in view the supply of light and power to this village.

Brantford, Ont.

The sale of the assets of the Grand Valley Railway Company and the Brantford Street Railway Company to the city of Brantford is expected to be completed by August 1.

Grand Forks, B.C.

The minimum charge for domestic electric light has been reduced to $1 per month and for power to $2 per month. It is also announced that when a consumer has paid an amount equal to $15 for the rental of his meter he shall become exempt from further rentals.

Halifax, N.S.

Halifax, N.S., and Charlottetown, P.E.I., are now connected by telephone as a result of the laying of a cable across the Strait of Northumberland, by the Dominion Government.

Hamilton, Ont.

The secretary of the Works Department estimates the maintenance cost of the street lighting system of Hamilton at $98,000 per annum.

Hawkesbury, Ont.

The Canadian British Insulated Company have a contract to supply Thomas Ross & Sons, Hawkesbury, Ont., with 4,200 feet No. 0 three conductor submarine cable working at 22,000 volt pressure. The cable will be in two lengths of 2,100 ft. and each reel will weigh 17 English tons.

Joliette, P.Q.

The council of the Town of Joliette, P.Q., at their meeting of June 24th, awarded to Escher Wyss & Company, of Montreal, the contract for the supply of one 200 h.p. Francis turbine and two belt-driven centrifugal pumps, each of two million gallons capacity. Messrs. Surveyer & Frigon, of Montreal, are the consulting engineers.

Kelowna, B.C.

Contracts have been awarded for power house equipment as follows:—Engine, condenser and heater, Goldie & McCulloch Company; 200 kw. generator with exciter, Canadian General Electric Company; switchboard panel and equipment, Canadian Westinghouse Company. The consulting engineer for the city of Kelowna is Mr. C. R. Yuill, successor to Mather Yuill & Company, Limited, consulting and contracting engineers, Vancouver, B.C.

Kincardine, Ont.

The by-law asking money for extension of the city lighting system was defeated.

London, Ont.

The general manager of the London hydro-electric system reports that there are now 7,400 municipal customers.

Lucan, Ont.

A by-law was recently passed authorizing the installation of an electric distribution system.

Medicine Hat, Alta.

Good progress is being made with the automatic telephone system at present being installed in Medicine Hat. Provision is made for 3,000 subscribers.

Montreal, Que.

The Montreal council have agreed to give the Montreal & Southern Counties Railway facilities for improving their city terminals. The company will be allowed to cross McGill street and establish the terminal on Youville Square, which will give considerably larger space for handling the cars.

After a prolonged hearing, Mr. Justice Archibald, Montreal, has given judgment in the case of Fraser, Brace & Company, against the Canadian Light & Power Company, awarding the former $65,330. The action was for a balance due on the contract price of constructing the defendants' power plant at St. Timothee, P.Q. The defence was that the work was not completed within the time specified and that the claim was more than met by sums due by plaintiffs to defendants under the head of liquidated damages. His lordship held on this point, that the extra work ordered by the defendants had seriously increased the time necessary for the completion of the contract.

The depression in the Montreal building trade is reflected in the electrical contracting business. New contracts are scarce, and the repair trade is almost negligible. The outlook is by no means rosy, as the indications are that very few large structures will be erected this season.

Operations have been re-commenced on the hydro-electric power project of the Stadaconna Power Company, P.Q., additional capital having been secured. The object of the scheme is to develop the Seven Falls on the St. Anne River, 27 miles below Quebec. The power will be distributed to that city and to neighboring places. Mr. A. R. Henry, Montreal, is the engineer, and Mr. E. A. Wallberg, Montreal, the contractor.

For the year ended April 30 the total revenue of the Montreal Tramways Mutual Benefit Association was $55,904, and the surplus $19,373. The company made a donation of $4,000. The total accumulated surplus is now $136,454.

Statistics of the relief work done during the year show general increases: 1,492 members were treated for sickness or injury, against 1,205 the previous year; $10,365 was paid out to them, against $10,065. Unfortunately, the death rate was higher, and $12,833 was paid for death and burial insurance, against $7,083. Mr. J. E. Hutcheson presided at the annual meeting of the association, when the following were elected the company's representatives for the year: Messrs. J. E. Hutcheson, E. A. Robert, J. L. Perron, A. Gaboury, D. E. Blair, Patrick Dubee, R. M. Hannaford and A. S. Boyd.

The Montreal Arena Company are about to install an artificial ice making plant, which will be electrically driven. Mr. J. Bennett, of Montreal, is designing the electrical equipment.

The Northern Electric Company have secured the order for 20,000 feet of wire for the Outremont council, the price being $93.50 per 1,000 feet delivered at the corporation yard.

Mr. Benjamin Smith, A.M.I.E.E., has been appointed electrical engineer of the Canadian Vickers, Limited, Montreal, and has charge of the electrical department of the dry dock and shipbuilding works at Maisonneuve. As we explained in our last issue, practically all the machinery of the plant will be electrically driven. Mr. Smith was formerly with Vickers, Limited, Barrow-in-Furness, England.

Port Arthur, Ont.

The city of Port Arthur will experiment on removing their garbage by a special electric railway car, now under construction. The garbage will be collected as at present with teams but will be transferred at two central points in the city. The long team haul to the refuse dump will thus be avoided.

Regina, Sask.

A contract has been awarded for a small quantity of single track extension work.

The operation returns of the municipal street railway, Regina, for the week ending June 27th are as follows: Revenue, $3,702.85; passengers carried, 90,224; passengers carried, including transfers, 102,697.

St. Catharines, Ont.

The hydro-electric street lights were officially turned on in St. Catharines on June 27th.

Saskatoon, Sask.

The city council at their meeting of June 29th accepted the tender of Messrs. Escher Wyss & Company, of Montreal, for one steam turbine-driven centrifugal boiler feed pump. The same company were also awarded a contract for one four-million gallon motor-driven centrifugal pump to operate against a head of 162 feet and one four million gallon motor-driven centrifugal pump to operate against a head of 40 feet. The motors and switchgear are of the Canadian General Electric Company's manufacture.

The city of Saskatoon have closed contracts for a quantity of power cable and electrical equipment. The order for 18,500 feet of 11,000 volt, 4 conductor, armoured cable has been given to the Canadian British Insulated Company, Montreal, and for 4,000 volt, four conductor cable to the Eugene Phillips Electrical Works, Limited, Montreal. The tender of the Western Electrical Company, Saskatoon, for three 400 kw. transformers, three 25 kw. transformers and switchboard equipment was accepted.

Contracts for electrical extensions, amounting to approximately $35,000, have just been awarded by the City Commissioners. The contracts include one for the laying of a cable from the local power house to the huge Dominion Interior Elevator on the outskirts of this city. All the successful contractors were local firms.

Three Rivers, Que.

The question of the installation of an electric railway in Three Rivers has been again revived. Mr. Jas. Bennett is retained as consultant.

Toronto, Ont.

The purchase of the entire plant of the Simcoe Railway & Power Company by the Hydro-electric Power Commission of Ontario is announced. The purchase includes both the plants of the Power company and their transmission system. The Commission also report excellent progress at Eugenia Falls, where both contractors are already hard at work. It will not be long before this section of Ontario is in a position to furnish from twenty to thirty thousand h.p. of hydro-electric energy.

General Superintendent Ross, of the Post Office Department, has forwarded the following interesting announcement to the city council."A contract has been entered into between the Post Office Department and the Dominion of Canada Postage Stamp Vending Company, Limited, of Toronto, and authority has been given for the erection of mail boxes on the streets. These boxes will require electrical means for illuminating and operating services and I am instructing the city accordingly."

The Ratepayers' Association of Lambton Mills and Scarlett Plains, two suburbs of Toronto, are co-operating to obtain a Sunday car service from the Toronto Suburban Railway Company.

The new Bathurst Street branch of the Bell Telephone Company's system, serving some 5,000 subscribers, was cut into service Saturday, July 4th, with something less than a minute's delay.

Winnipeg, Man.

The gross operating revenue of the Winnipeg Municipal Electric System for the year ending April 30th, 1914, as just made public by Mr. J. G. Glassco, general manager of the system, was $865,805.19. Operating expenses were $490,582.06. After allowing for interest and depreciation to the extent of $295,141.45, there is a net revenue remaining of $81,897.45.

A contract has lately been awarded to the Canadian Westinghouse Company by the city of Winnipeg for the supply and installation of two 6,000 kv.a. synchronous condensers with necessary transformers. These machines are to be installed at the terminal station of the Light and Power Department for the sole purpose of improving the power factor of their system, and it is not the intention to impose on them any mechanical load. It is expected to increase the capacity of the transmission line by 50 per cent. by this means. The switching equipment in this connection will also be supplied by the Canadian Westinghouse Company.

A contract has been awarded by the city of Winnipeg to the Canadian Westinghouse Company for two single phase, 2,200 volt feeder induction regulators of 44 kv.a. capacity each.

The Standard Underground Cable Company have been awarded a contract by the city of Winnipeg for 40,000 pounds of weather-proof wire.

The Canadian General Electric Company have been awarded a contract by the city of Winnipeg for 500 to 1,000 electric irons.

The Canadian British Insulated Company have been awarded a contract by the city of Winnipeg for 5,500 feet of 250,000 c.m., 13,000 volt, 3-conductor cable, the contract to include installation and jointing under a five-year guarantee.

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Overhead Line Construction

A most valuable report was presented by the Committee on Standardization of Overhead Line Construction at the recent convention of the Canadian Electrical Association. This report covers all voltages up to and including 35,000 using wooden poles only. The value of the report depends very largely on the drawings which accompany it and which indicate the recommended standards much better than any description, however lengthy, could do. While the committee places itself on record as being opposed to too strict a standardization, they have very fully outlined a system of construction which might well be followed within very close limits. Indeed, many of the illustrations represent equipment that has already been standardized by a number of the larger companies.

Among the benefits to be derived from standardization it is mentioned that the costs of manufacturing would be less; that it would not be necessary to carry such large reserve stocks; that this also would assist the small jobber whose capital may not be sufficient to carry a complete stock of all the various fittings and who with the smaller stock would be satisfied with a closer margin of profit; and that the customer benefits in being able to obtain his fittings more readily and without the necessity of carrying a large stock himself. It may be added that the ultimate consumer might benefit to a considerable extent by reduction in overhead expenses all along the line which in itself is a consideration worth noting.

We believe this is one of the most valuable reports ever prepared on this subject and are glad to be able to reproduce it with the very complete set of drawings which accompany it, on other pages of this issue. We know that every suggestion made in this report is the result of actual, tried experience and central stations and others may safely accept them as certain to produce thoroughly safe and satisfactory results.

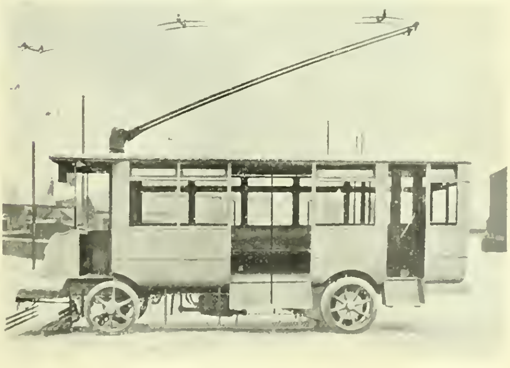
Present Status of Prime Movers

The Committee on Prime Movers recently made a report to the American Institute of Electrical Engineers on the present status of the various types of prime mover equipment at present available. The report covers the reciprocating steam engine, the gas engine, the steam turbine, the oil engine and finally the hydraulic turbine, treating each separately as to its cost, efficiency and the field to which it is best suited.

According to this report the reciprocating steam engine has become practically obsolete for use in modern power stations. The steam turbine is placed at the head of the list of prime movers. The possibility of using natural gas and blast furnace gas has greatly enlarged the field of the gas engine; in addition the fact that fuel can be obtained either from coal, coke, lignite, peat, wood, oil or other kindred fuels has resulted in the very general use of this type of engine. In Europe the Diesel engine has made considerably more progress than on this continent; under favorable conditions the cost of operation is very low but in the larger capacities the weight of the engine increases unduly and, consequently, its size is out of proportion to the increase in capacity, so that the limiting value for this engine is somewhere in the neighborhood of 2,000 kw. Respecting hydraulic turbines the most important development has been the increase in efficiency which now runs in the neighborhood of 90 per cent. This is true not only at full load, but for a wide range of fractional loads. The report notes the trend towards the single runner, vertical shaft type of turbine for low and medium head and mentions the Keokuk plant. Reference might also have been made to the Cedars Rapids development where this type of turbine is being used and where, we understand, the largest units in the world to date are being installed. The article is very fully illustrated by curves which indicate the operating efficiencies and cost of the various types discussed. We reproduce these with the article complete on other pages of this issue. The paper will, we believe, stand as the best available reference on the subject of prime movers for some time to come.

Trackless Electric Cars

The favorable reception that has been accorded the trackless trolley car in the British Isles has resulted in a number of recent improvements in the design of this type



Latest type trackless trolley car.

of car, which appear to have removed many of the original objectionable features. The latest type approaches more nearly to the standard rail car of the present day, being equipped with a front safety guard, low steps, centre entrance, etc. The floor of the latest design of car has been brought down as near to the roadway as possible so that only one step is now necessary to reach the deck. The car has two compartments, and the entrance to each is at the side. A life guard has been fitted in addition to the customary wheel guards, and from tests made in the usual way with dummies, very satisfactory results are claimed to have been obtained. The improvements in design of this latest car have also resulted in increased accommodation with reduced weight. The car is driven by two 28 h.p. motors, each geared to a rear wheel. The lower cost of construction and the flexibility of the system, which allows the car to operate on any kind of a roadway where the trolley wires have been installed, are making this type of vehicle very popular in less thickly populated districts. For conditions obtaining in some of the suburbs of Toronto at the present time, as well as possibly in other Canadian towns and cities, a car of this type would appear to offer a very satisfactory solution.

The Late Dean Galbraith

Graduates of the "School" have heard with profound regret of the death of their much beloved Dean on the morning of July 22 at his summer place on "Go Home Bay."

For nearly fifty years Dean Galbraith has been the moving and guiding spirit of the School of Practical Science, now the Faculty of Applied Science & Engineering of the University of Toronto.

Dr. John Galbraith.

Indeed, Dean Galbraith and the school have been so inseparably associated that it is impossible yet to think of his place being taken and his work carried on by another. It is safe to say that the University of Toronto have rarely been confronted with a more difficult task than the choice of a successor.

The life history of Dr. Galbraith is so well known, not only to students of engineering but to practically every layman from one end of the Dominion to the other, that it seems superfluous to add anything at this time. The graduates who were fortunate enough to be able to attend on the occasion of the celebration of the Dean's 50th anniversary of his entrance to the university as a freshman, which was held on December 5 of last year, will now count themselves doubly fortunate. This occasion now appears more than ever a fitting climax to a long life of resourceful and productive effort towards the betterment of engineering conditions in Canada. Dean Galbraith will ever be remembered by the graduates of Toronto as the man who placed the Engineering Faculty of the University of Toronto on a par with the best the universities of the world have to offer.

Electric Drive in Lumber Mills

In British Columbia, where the lumbering industry is of paramount importance, the application of electric drive to lumber mills has the close attention of mill owners, the electrical engineering profession and supply companies.

The most recent instance in this province of electric drive being adopted for this purpose is at the McLelan Lumber Company's new mill, situated at Ladner, about 12 miles due south of Vancouver, which commenced cutting last March. The plant, which has a daily capacity of about 125,000 feet, and provides employment for a mill crew of 100 men on an average, occupies a site covering 10 acres on the South Arm of the Fraser River. Steam as well as electric power is utilized, the planing mill being operated by electric drive, while the sawmill is driven by steam.

The sawmill power house is a cement structure 40 x 48 feet in size. It contains a battery of three 72-in. x 18 ft. return tubular boilers, each carrying 160 lbs. pressure. The boilers, which were manufactured by the Vulcan Iron Works, New Westminster, have "Dutch Oven" settings and are fed automatically from overhead.

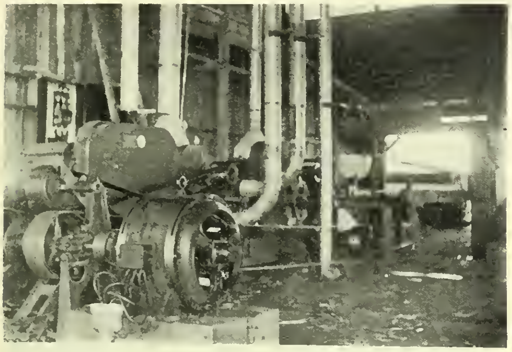
The engine room adjoining, built of cement and brick, is 44 x 40 ft. in size. In it is a pair of Lane & Bodley Company twin engines, 17 x 24-in., capable of developing 600

Direct driven machine in McLelan Lumber Company's plant, Ladner, B. C. –showing motor and starter.

h.p.; also a Worthington pump 10 x 6 x 10-in., capacity 500 gallons per minute, which is being used for fire protection for the time being.

The planing mill is 40 x 60 ft. in size, with cupola roof, there being two 24 ft. overhang additions on the north and south sides; on the east side is the grinding room, 16 x 40 ft. The equipment of machines comprises one Berlin No. 91 fast feed planer; one Berlin No. 108 inside moulder; one Berlin self-feed ripsaw; one 60-in. Mershon resaw; one 48-in. three-drum sander; and four swing cut-off saws. All machines in the planing mill are driven by individual motors

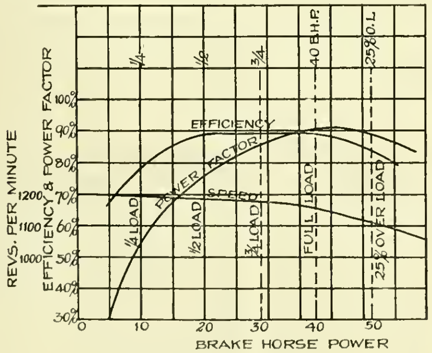
varying in size from 1 h.p. to 50 h.p., three of the motors being direct connected to the driven machines. Electric current is furnished by the Vancouver Power Company, a subsidiary concern of the B. C. Electric Railway Company, the pressure being 220 volts, 3-phase at 60-cycles. The blow-piping system serving the machines was installed by Feix Company, Vancouver. It collects the shavings and sawdust



Another view of direct connected machine in McLelan Lumber Company's plant, Ladner, B. C.

from each and delivers same through a long pipe to feed the boilers in the sawmill power house. The system is equipped with a double 55-in. Sheldon fan, electrically-driven, and installed in such a way as to work very economically in consumption of current.

Lumber cutting being fairly intermittent and varying in proportion to the size of the cut, a problem of interest to the mill owners is—after ascertaining the size in B.h.p. of the motor required—to find a motor having a long range of efficiency around the normal load of the motor. In such a choice there is much money to be saved. The accompanying set of curves for a 40 B.h.p. motor at the McLelan Company's mill shows the efficiency between ½ load and full load to be nearly a straight line, while the efficiency at ¼ load is 79 per cent and at 25 per cent overload 84 per cent. At the same time this set of curves demonstrates the fact that a motor must not be overloaded to any great extent if the lumber to be cut is to be a paying proposition. Very often one or more overloaded motors eat up the cost of the purchase of larger



High motor efficiency over wide range.

motors, the mill owner not being aware of the actual loss, as the current bill is spread over a number of motors and a number of cuts of varying sizes.

Another feature of the electric installation at Ladner is the "fool proof" starting devices. The starting handle cannot be thrown into the "running" position without first engaging with the "start" position. A time lag or slow motion device compels the operator to hold the handle in the "start" position for the predetermined length of time; any premature attempt to engage with the "running" position merely brings the handle to the "off" position. The starters are also fitted with "no-volt" and "overload" circuit-breakers which bring the starting handle to the "off" position in cases of failure of supply or overload. The overload breakers being in circuit in the "running" position only, can be set at a load to protect the motor and at the same time save fuses.

The smaller motors from 25 B.h.p. down are fitted with ball-bearings and require no lubrication for periods of twelve months and upwards. The standard of temperature adopted is 72 deg. Fah. (40 deg. Cent.) when running continuously at full load.

The motors in the planing mill of the McLelan Lumber Company were supplied and connected by Messrs. P. E. Harris & Company, Limited, Vancouver, who are the agents in B.C. for the makers, Messrs. Harding, Churton & Company, Limited, Leeds, England. The electrical department of Messrs. P. E. Harris & Company, Limited, is under the management of Mr. W. W. Fraser.

Training Telephone Operators

With a view to securing as perfect a service as possible the B. C. Telephone Company devotes a considerable amount of attention to the training of its operators, the success attained in this direction being clearly demonstrated by the steadily decreasing number of complaints, notwithstanding the constant growth of subscribers. About two years ago the company established a training school for operators in a building adjoining its Fairmont exchange at Vancouver and maintains there all the equipment necessary to enable the prospective operator to become thoroughly familiar with her work.

In the first place after careful selection of candidates, attention is paid to pronunciation and enunciation, a teacher of elocution being retained for this purpose. Other of the chief points to which particular emphasis is given in the course of instruction are promptness, accuracy and courtesy.

The equipment at the training school at Fairmont ensures practise on calls of all types. It consists of six "A" operating positions and a monitor's desk of two positions. Three of the "A" positions are of the multiple type and three are of the ancillary type. There are twenty answer jacks, and those being utilized represent all classes of tele-

Fig. 1—Front of switchboard.

phone service, including the two different kinds of pay stations, the coin-box, measured rate, flat rate, and individual and party lines. The working lines are scattered throughout the multiple so that an operator in reaching for them becomes familiar with locations throughout the switchboard.

The monitor positions are so equipped that the monitor can first act as the originating subscriber, and place a call. She is then able to be the "B" operator on either ring down or call circuit trunks and can finally become the called subscriber, or all three at once. During these evolutions she has an absolute check on the student. She knows whether the student answers properly, calls the proper number, takes the right trunk, speaks well over the call circuit, meters properly on measured service lines, in short, she knows exactly how everything is done. She can "fish" for either the calling or called subscriber, she can cause a cut-off and then complain about it, in fact, she can do any of the various things which enter into the giving of constant telephone service.

Fig. 1 gives an excellent view of the front equipment of the switchboard at the Fairmont school. All exposed woodwork on the front of the switchboard is polished mahogany and the exposed woodwork at the rear of the switchboard is birch stained to match the mahogany.

Positions 1-2-3 are equipped for message register and coin collect service and have a subscribers multiple similar to that in use on the "A" and "B" switchboards in the company's Seymour office, and to the "B" switchboards in the Bayview, Fairmont and Highland offices.

Positions 4-5-6 are equipped for regular flat rate service and have ancillary answering jacks similar to the "A" boards in the Bayview, Fairmont and Highland offices.

The double row of lamp caps extending from one end of the switchboard to the other just above the keyboards,

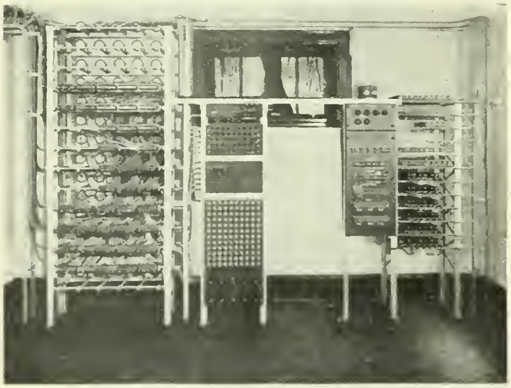


Fig. 2—View of apparatus room.

are the answering jacks where the signal from the subscribers appears.

Above the answering jacks in panels 1-2-3-7-8-9-13-14-15 is the out trunk multiple with jacks designated for the various Vancouver and two-number offices. Above the out trunk multiple and in panels 1-10 is the regular subscribers multiple of 2400 lines. Near the top of the switchboard to the right hand end are the ancillary answering jacks. These are multipled from the regular answering jacks in the first section. The lamp caps at the top of panels 5 and 13 are the supervisors' call signals.

When an operator calls her supervisor, the supervisor's signal in the particular section lights and operates a relay which causes a bell to ring.

Fig. 2 shows a view of the apparatus room. To the left can be seen the cables coming from the switchboard and connecting to the intermediate distributing frame. This frame is also cabled to the relay rack which is adjacent to the intermediate distributing frame and to the fuse panel of the repeating coil racks, shown to the right.

At the intermediate distributing frame, lines from the switchboard are connected to the apparatus required for the different types of line circuits. All the relays required on the

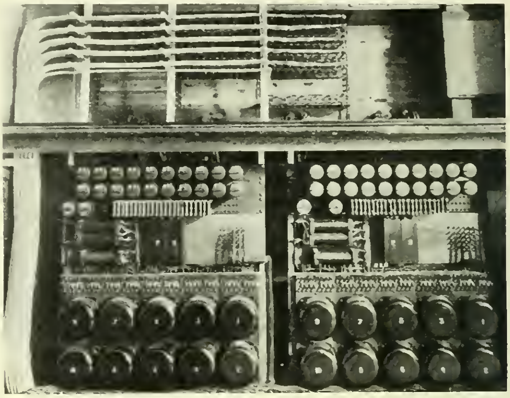


Fig. 3—Rear of Instructor's desk.

line circuits, on the switchboard, and on the instructor's desk are mounted on this relay rack.

The repeating coils used in the operator's cord circuits on the switchboard and the condensers used in the trunk circuits on the instructor's desk are mounted on the repeating coil rack.

The fuse panel is made from 1¼-in. Monson Maine slate and is equipped with fuses for all the circuits used on the switchboard and instructor's desk.

Fig. 3 shows the rear equipment of the instructor's desk. To the left can be seen the cables connected to the jack strips, lamp strips and message registered relays on the instructor's desk, to the intermediate distributing frame.

The lower portion of the desk contains the operator's telephone and cord circuit equipment required on the desk.

In installing this school at Fairmont exchange the B. C. Telephone Company have gone to considerable expense. It is felt, however, that this is justified by the results. The object of the company is to give as perfect a service as possible and to do this the training school for operators is considered an absolute essential.

Canadian National Attractions

The management of the Canadian National Exhibition have issued Bulletin No. 2, describing more fully the attractions and educative features of this year's show. As already announced, the electrical decorations will be a striking feature. Over the entrance the Union Jack and the Stars and Stripes will be entwined with the Dove of Peace floating over them and with two electric panels at the sides, one emblematic of Canada and the other of the United States. The Grand Plaza has been strung with a net-work of wires and will be canopied with twinkling electric stars. Among the other features described in this bulletin are the Boy Scouts, the Musical Ride, Art, Processes, Canada's Resources, Motor Polo, Midway and "Babylon," the wonderful Oriental spectacle in which the stage setting will consist of a view of the ancient city 700 feet in length—the largest stage in the world.

Switchboard Back Connections

By W. A. Coates, A. M. I. E. E.

The proper design of switchboard connections is a matter which has received but little publicity. Manufacturers have experimented from time to time, but their findings have not been published. Consequently, individual designers each have their own "pet rule," the most popular being that which calls for a density of 1,000 amps. per sq inch section of copper, quite irrespective of the total current, or of the manner in which the conductor is subdivided. These same men would be horrified at the proposal to employ such a "rule" in designing any other apparatus.

The only excuse for this practice is that when using bare conductors there is no danger of damaging insulation by overheating, as in a machine winding, and from this point of view a little slackness does no harm.

It should be borne in mind, however, that heat always tends towards even distribution, and if in a system of switches and connections the latter are at the highest temperature, the heat will naturally flow to the switches. Air break switches and circuit-breakers generally have their contact faces lubricated with a smearing of vaseline, to ensure smooth working. It is very undesirable that they should get at all hot, as it would quickly cause the vaseline to thicken, thus introducing contact resistance, and setting up local heating. This is obviously a cumulative effect.

These points are generally appreciated by the larger manufacturers. The standard temperature rise both in America and Europe appears to be 30 deg. C., while British manufacturers are usually more conservative, and have adopted 20 deg. C. as a limit. On the other hand, it is not unknown for German manufacturers to work up to 40 deg. C., possibly when competition has been unusually keen.

On d.c. switchboards the factors which affect the temperature of conductors are the current passing, the cross sectional area of metal, and the effective radiating surface. The conductivity of commercial copper is so uniform that it may be neglected.

Connections should be placed on edge as far as possible, so as to get the full benefit of convection. With a bar lying flat the upper surface only is of full value, as the warm air will tend to lodge against the under-side, and prevent efficient radiation. This point is especially important in locating ammeter shunts. A difference of 15 deg. C. was observed in the case of a 4000 amp. shunt, between the temperature rise when flat and when on edge.

Where multiple conductors are employed, their total carrying capacity is largely affected by the spacing between them. It has been found experimentally that for all faces of each conductor to be effective radiators, there should be a space of at least 5/8-in. between each. This is rarely possible of attainment at the back of a switchboard carrying heavy currents, and it is therefore necessary to make a suitable allowance in rating multiple conductors.

The tables given below have been compiled from the experimental figures obtained by several of the leading makes of switchboards:—

Maximum Permissible d.c. load in amps. Single copper straps

Size	Section Sq. Ins.	Maximum guaranteed temperature rise 20 deg. C	30 deg. C	40 deg. C
1" x 1/16"	.0625	130	160	185
1" x 1/8"	.125	185	230	260
1" x 1/4"	.25	265	325	375
1½" x 1/8"	.1875	275	340	390
1½" x 1/4"	.375	390	480	550
2" x 1/8"	.25	360	445	510
2" x 1/4"	.50	515	630	730
3" x 1/8"	.375	490	600	690
3" x 1/4"	.75	690	850	975
4" x 1/8"	.5	610	750	860
4" x 1/4"	1.0	870	1060	1230
6" x 1/8"	.75	940	1150	1320
6" x 1/4"	1.50	1330	1630	1880

It will be seen that taking the 30 deg. C. rise as standard, and for a given current, the conservative English rating of 20 deg. C. means the use of 23 per cent. more copper, while with the cheaper German construction working to 40 deg. C. there will be 13 per cent. less copper used.

The great advantage of using thin straps is also apparent. The radiating surface of a 1/8" strap is practically the same as that of a 1/4" strap, and although the resistance is of course double, the carrying capacity is only decreased 30 per cent. In the next table, therefore, only 1/8" straps will be taken into account.

Maximum permissible d.c. load in amps. Copper straps in multiple

Guaranteed temperature rise not exceeding 30 deg. C.

No. of straps	Size each strap.	Total section sq. ins.	Straps spaced apart ⅛"	¼"	⅜"
2	2" x ⅛"	.5	760	785	860
	3" x ⅛"	.75	1000	1030	1140
	4" x ⅛"	1.0	1270	1320	1450
	6" x ⅛"	1.5	1950	2030	2220
3	2" x ⅛"	.75	880	1070	1250
	3" x ⅛"	1.125	1200	1440	1680
	4" x ⅛"	1.5	1500	1800	2100
	6" x ⅛"	2.25	2320	2770	3230
4	3" x ⅛"	1.5	1320	1700	1970
	4" x ⅛"	2.0	1650	2120	2460
	6" x ⅛"	3.0	2530	3260	3760
5	3" x ⅛"	1.875	1560	2060	2430
	4" x ⅛"	2.5	1950	2580	3040
	6" x ⅛"	3.75	3000	3960	4650
6	3" x ⅛"	2.25	1800	2430	2880
	4" x ⅛"	3.0	2250	3040	3600
	6" x ⅛"	4.5	3450	4650	5500
7	3" x ⅛"	2.625	2040	2800	3330
	4" x ⅛"	3.5	2550	3500	4170
	6" x ⅛"	5.25	3900	5360	6400
8	3" x ⅛"	3.0	2280	3160	3780
	4" x ⅛"	4.0	2850	3950	4730
	6" x ⅛"	6.0	4370	6050	7250
9	3" x ⅛"	3.375	2520	3530	4250
	4" x ⅛"	4.5	3150	4420	5300
	6" x ⅛"	6.75	4830	6750	8150
10	3" x ⅛"	3.75	2760	3900	4700
	4" x ⅛"	5.0	3450	4870	5870
	6" x ⅛"	7.5	5300	7480	[illegible]
11	4" x ⅛"	5.5	3750	5320	6450
	6" x ⅛"	8.25	5750	8170	9900
12	4" x ⅛"	6.0	4050	5760	7020
	6" x ⅛"	9.0	6200	8860	10770

On most switchboards, flat strap is used as being handier and cheaper for connecting on to switch studs, etc. The switch studs themselves, however, are almost invariably of round rod, and occasionally rod is also found more convenient for connections.

The actual method of making connections is a question which has already been treated in a very interesting manner in a paper by Mr. F. W. Harris in the Electrical Journal. In this it was shown how the contact resistance varies inversely as pressure between faces, up to a very high limit. In view of this fact, it would hardly seem necessary to insist on the desirability of using clamp connections on all save the smallest conductors. With bolted connections, good contact and even distribution of pressure is difficult to obtain.

Even on the best fitted boards, the contacts will be

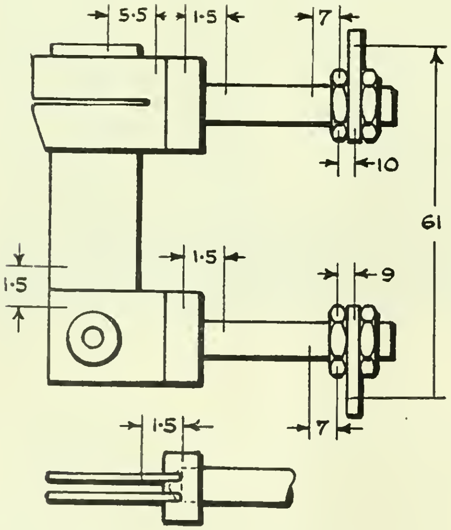
found to show appreciable resistance, and all efforts should be directed to cutting out unnecessary joints. As illustrating this point, the following case may be cited:—

A test was made to ascertain the drops across various parts of a standard 700. amp. knife switch with full load passing. The figures obtained are shown on the accompanying illustration. The actual current path, from terminal to terminal was about 27 in., and the minimum copper section .785 sq. ins. The drop across a straight piece of copper of the same length and section would only be 16.75 milli-volts, as against 61 milli-volts on the switch. This speaks for itself in emphasizing the attention which should be paid in designing, so as to reduce as far as possible the number of joints, be they sweated, screwed or clamped.

Maximum permissible d.c. load in amps. Round Copper Rod

Dia. ins.	Section sq. ins.	Maximum guaranteed temperature rise 20 deg. C	30 deg. C	40 deg. C
3/16"	.0276	58	70	80
5/16"	.0767	124	150	175
3/8"	.1104	164	200	230
1/2"	.196	250	305	350
5/8"	.307	350	425	490
3/4"	.442	462	565	650
1"	.785	712	870	1000
1⅛"	.994	850	1040	1200
1⅜"	1.485	1146	1400	1600
1⅝"	2.074	1475	1800	2080
1⅞"	2.76	1825	2220	2580
2"	3.14	2010	2460	2840
2¼"	3.97	2400	2830	3400
2½"	4.90	2800	3400	3950

It will have been noticed that all the figures tabulated above have reference to d.c. only. To make a similar tabulation for a.c. working would be virutally impossible, ow-



Showing drops across various parts of knife switch.

ing to the effect of mutual induction between conductors, and to a smaller extent, skin effect.

As an example, let us assume a 60 cycle system with conductors spaced 3-in. centres; four 3" x ⅛" bars in multiple would carry about 1000 amps.; six bars would carry 1400 amps.; 8 bars would carry 1650 amps., and 16 bars 2000 amps.,—all figures being based on a 30 deg. C. rise.

The only possible way of dealing with heavy alternating currents is to follow furnace practice and interleave the conductors of each phase. Fortunately, it is only rarely necessary to switch large alternating currents, and in these cases the designer must calculate his copper sections to meet his particular lay-out.

Safety First

The Toronto Railway Company are active supporters of the Ontario Safety League. This has been shown in the distribution of literature to their employees, together with lectures and special instructions, in addition to financial

support. They have now adopted a somewhat novel but very effective scheme for further impressing the necessity of precaution.

The "Car Stop" poles of the Toronto Railway Company are painted white for some seven or eight feet from the ground and the location of the stops further indicated by the words, printed on these white poles, "Cars Stop Here." Recognizing that this is a sign which is read by every person who boards a car, the company are placing immediately below the original words, the further words in larger letters, "Safety First." To further attract the attention of the passengers, these words are painted in red. We understand that all car stop poles in the city are to be treated in this way.

The idea is a most commendable one and will undoubtedly be productive of excellent results. The illustration herewith represents one of the signs in the down-town district of Toronto.

Mnemonic Symbolizing of General Stores

By Wilfred G. Astle*

The object of a symbol system in the classification of General Stores is to furnish a shorthand method of designation. The symbols should contain suggestions and aids to remembering the names of the articles, so as to make it as easy as possible for a person knowing nothing about the system to locate the material in the classification as quickly as possible, after spending a few minutes in receiving explanation or studying the primal elements of such symbolization. If the classifications are such that they contain no suggestions of the material classified, it would be dependent entirely upon the memorizing of the classification by the person using it, which would be a difficult and unnecessary task.

A good symbol system should be so constructed that it will be complete, simple, flexible, uniform, and conform to all other symbol systems used in other parts of the plant, therefore, it is best when considering the installation of such a system to map out in advance all the general classifications that will be required so as to insure a uniform system.

There are three points that should always be considered when working out a symbol system for General Stores and that is:

(1) The classification should be as far as possible an aid to memory, by representing the initial, secondary, or prominent letter of the article represented.

(2) To enable convenient location of material in the storeroom by order of symbols.

(3) The classification should be such as to enable perpetual inventories in the Controlling Accounts to be kept by the main classes of material for administrative check in quantity of materials on hand in proportion to the business and orders received or schedule for work drawn up.

The letters used to denote any particular article or division in the classification should primarily be the initial letter of the name of such article or division, so that in reading the symbol the thought first goes to the letter shown as the initial of the required word.

In cases where the initial letter has already been used for another article or division the secondary letter should be used. This secondary letter, should be the letter, which, aside from the initial letter, has the most prominent sound and consequently would be secondmost prominent in the thought of the person reading the symbol.

If the initial and secondary letters have both been used already for other items the next most prominent letters should be taken.

In cases where, owing to the repetition of initial letters on the articles to be classified, it is found impossible to use a letter which would indicate the word itself, and in such cases it is necessary to leave the interpretation to the memory.

The first letter used for all General Stores symbols is S, meaning Stores, and this letter as the initial letter of a symbol should be omitted from all other classifications so that all symbols beginning with S, will indicate that it is General Stores, or Material Purchased from Outside.

The second letter should be the initial letter of the name for the particular work or article that the material is used for, to cover Stores used exclusively for that work, as for example—

SA—Stores used for Automobile Repairs.
SG—Stores used for Lines Underground.
SH—Stores used for Lines Overhead.
SS—Stores used for Sealed Services.

* Storekeeper, Toronto Electric Light Company.

ST—Stores used for Transformers.
SW—Stores used for Wiring Purposes.

Such material which is carried in Stores and used for a number of purposes, apart from that which is used for certain specific work only, should be classified under V—SV meaning Stores used for various purposes.

The third letter should signify the nature of the material and should be used regardless of whether the second letter is V or one of the others, indicating the general classes of work. For example, STC would mean Castings for Transformers in Stores, and SVC would mean Castings for Various Purposes in Stores.

The third division of letters for SV (meaning Stores for Various Purposes), would be as follows:

SVA—Abrasives.
SVB—Bars.
SVC—Castings and Forgings.
SVD—
SVE—Electrical Apparatus, Fixtures and Fittings.
SVF—Fastenings (Articles which hold or are held).
SVG—Gages, Gage Glasses, and Measuring Instruments.
SVH—Lumber.
SVK—Miscellaneous Metals.
SVL—Liquids.
SVM—Lump Material.
SVN—Oil and Grease Cups, Lubricators.
SVP—Powders, Crystals, etc.
SVR—Greases, Pastes, etc.
SVS—Sheets.
SVT—Tools and Implements.
SVV—Plates.
SVW—Wire.
SVX—Shop fixtures.
SVY—Yardage.
SVZ—Miscellaneous.

The fourth letter of the classification is the general subdivision of the three letter symbol. For example, under SVA (meaning Abrasives, for Various Purposes in Stores), would be given:

SVAD—Discs and Wheels.
SVAM—Lump Abrasives.
SVAP—Powdered Abrasives.
SVAS—Sheet Abrasives.

and under SVB (meaning Bars, for Various Purposes in Stores), would be given:

SVBA—Structural Shapes.
SVBB—Brass Bars.
SVBC—Copper Bars.
SVBF—Fibre Bars.
SVBM—Machinery Steel.
SVBP—Pipe, Tubing, etc.
SVBR—Cold Rolled and Cold Drawn Steel.
SVBS—Solder.
SVBT—Tool Steel.
SVBY—Babbit Metal.
SVBZ—Miscellaneous.

The fifth letter of the symbol should be the particular kind of article in the subdivision shown by the fourth letter. For example, SVAD (meaning Abrasives, Discs and Wheels, for Various Purposes in Stores), would be given:

SVADB—Bristle Buffing Wheels.
SVADC—Carborundum Wheels.
SVADE—Emery Discs.
SVADG—Grind Stones.
SVADR—Rag Buffing Wheels, etc.

As a further example of the fourth and fifth letters we

will take SVB (meaning Bars, for Various Purposes in Stores), in which would be SVBB (meaning Brass Bars for Various Purposes in Stores):

SVBBF—Flat or Rectangular Brass Bars.
SVBBH—Hexagonal Brass Bars.
SVBBX—Octagonal Brass Bars.
SVBBR—Round Brass Bars.
SVBBS—Square Brass Bars.
SVBBT—Triangular Brass Bars, etc.

If a further subdivision should be necessary to fully describe an article, a sixth letter can be used. This sixth letter should indicate the different makers of the five-letter symbol, and should be if possible the initial of the manufacturer's name or trade name of the article.

Except in very rare cases where all other letters are exhausted, I, J, O, Q, and U should be omitted, for the reason that in connection with figures adjoining the symbol letters, the I, O, and Q might be mistaken for figures, and J and U might be mistaken for each other or for V.

After the last letter should be given the size of the article. In giving size, absolute uniformity should be followed as to dimensions indicated by the relative position of the figures.

When three figures are used in giving dimensions, they should be given in the order of thickness, breadth and length. When one dimension only is given, it should indicate thickness or diameter. If two figures are given, the thickness should be given first and the breadth last. In the case of cylindrical articles, the first figure should be the diameter, and the last figure the length, and with tubing the first figure will be the outside diameter, the second the gage or inside diameter and the third the length.

Whether this method of designating dimensions is used or the opposite, does not matter very much, as there are good points in favor of both, but it is most essential that some one method be adopted for general use.

Care should be taken in working out symbols to make them practical and not allow long symbols for the sake of adhering to a theoretical point of complete description. For example, under Pipe, Tubing, etc., SVBP (meaning Bars, Pipe, for Various Purposes in Stores) the affixing of the letter B making it SVBPB would indicate Brass Tubing and the affixing of the letter R making it SVBPR would indicate Iron Pipe (indexing by the R in Iron). From a straight theoretical standard of mnemonic description it would be considered proper to indicate Nickel Plated Brass Tubing by the letter X following the symbol for Brass Tubing, but, under this general division, Pipe, Tubing, etc., there are plenty of unused letters and it is far more practical to show Nickel Plated Tubing in the same division as Brass Tubing, making a five-letter symbol instead of a six. Therefore we would indicate it as SVBPX.

It is better, except in possibly very rare instances, to make the general classification by the shape of the material; for example, as shown in the subdivision of SV—all bars are given in one group no matter what the material, whether hollow bars, such as pipe and tubing, or iron bars. The reason for this is that it is most convenient to store all these articles in one section of the storeroom in racks built for bars, which makes it easier to locate the material by the symbol when all such material is stored in one place, the storage properly sectioned off according to subdivisions of the general class, than it would be under the method of keeping all brass and brass products under one general class, copper, steel, wrought iron, etc., and products of same under another general class.

Under the division of SV, in the first part of this article, the object is to include in a general class all articles of the same general shape and requirements as to storage. But, sometimes this method is not practical, in such cases the classification is made to cover all articles used for a specific purpose and the first subdivision SVA—Abrasives, is an illustration of this. Under SVA are included various forms of abrasives from discs and wheels, lump and powdered material to sheets, but as these are used for the same general functions of grinding, polishing or buffing, it is most convenient to have them all together in one section of the storeroom.

Under SVC, all castings and forgings are stored in one section of the storeroom. These classes should then be subdivided according to the material something as follows:

SVCA—Aluminum Castings.
SVCB—Brass Castings.
SVCC—Copper Plated Iron Castings.
SVCF—Steel Forgings.
SVCG—Grey Iron Castings.
SVCM—Malleable Iron Castings.
SVCN—Nickel Plated Iron Castings.
SVCP—Nickel Plated Brass Castings.
SVCS—Steel Castings.
SVCZ—Bronze Castings.

Under SVE would be located for convenience for storing all electrical apparatus, fixtures and fittings, etc.

SVF—Fastenings, covers all articles which hold or are held regardless of the material used for same. This will include all bolts, nuts, screws, springs, pins, nails, studs, etc., which are naturally stored in one section.

Under SVS will be included all sheets of whatever nature, these requiring special storage racks, ordinarily being adjustable shelving or racks of varying sizes for the different material carried, but of general standard dimensions. The subdivisions of Sheets would be ordinarily as follows:

SVSA—Aluminum.
SVSB—Brass.
SVSC—Copper.
SVSF—Fibre.
SVSG—Galvanized.
SVSK—Packing.
SVSL—Lead.
SVSM—Mica.
SVSN—Tea Lead.
SVSP—Paper.
SVSR—Iron.
SVSS—Steel.
SVST—Tin.
SVSV—Vulcasbestos.
SVSZ—Zinc.

Thus it will be seen by these few instances as given above that the best method of general classification is according to the nature and shape of the material, which enables the storing, and later the locating of the material desired to the best advantage.

Valuable work in the mnemonic symbolizing of General Stores or Raw Material has been done by Mr. Frederick W. Taylor and Mr. Carl G. Barth. Their methods have served as the starting point of the system which I have endeavored to describe in this article.

One Man Cars

Four one-man, semi-convertible, prepayment cars have recently been placed in commission in Portland, Oregon, by the Portland, Eugene & Eastern Railroad Company. These cars have metal under-frame and wooden body. The general dimensions are: length of body 21 ft.; length over all 30 ft. 7½ ins.; bolster centres 13 ft.; width over sills 7 ft. 9½ ins.; top of rail to sills 2 ft. 5¼ ins. The front platform of each car has a pair of hinged folding doors and folding steps for regular entrance and exit and an additional emergency exit with folding door and folding step is located in the rear of the car. The total seating capacity is 36, including a broad curved seat extending across the rear of the car. The body of the car contains six rattan cross seats on each side of the aisle and longitudinal seats.

Overhead Construction Standards

Describing a Complete Line of Fittings and Devices Covering all Classes of Over-head Line Work up to 35,000 Volts, With Wooden Poles

In presenting this report to the members of the Canadian Electrical Association, at their Twenty-third Annual Convention; the members wish to be placed on record as being opposed to Standardization in its literal interpretation. By absolutely standardizing on any one method of accomplishing a desired result the Association would block further progress in the Art, if such it may be termed, of Overhead Line Construction; as, any departure from Standardized methods, even if a marked improvement or advance in the art, might lead to serious complications in the event of failure from any cause of such departure to properly do its work.

With this in mind your committee herewith present suggestions for a complete line of fittings and devices covering all classes of overhead construction up to 35,000 volts and designed for use with wooden poles.

The use of poles other than wood has not been covered; as your committee feel that, while other forms of poles offer in many cases a better solution of the problem, they are not sufficiently advanced in design to permit of offering designs which could even remotely approach being standard. Such special poles should, however, have the careful consideration of our engineers before definitely deciding to stick to the older wooden pole type of construction. It is suggested however that in considering such special types particular attention be given to a design which will permit, to a large extent, the use of fittings of same standard as used on wooden poles. If this is done the pole only becomes special and stock fittings may be provided for either type of pole with a minimum storeroom investment.

The report as submitted consists largely of working drawings, made with the idea of having member companies use this report, if it meets with their approval, as a field instruction book for the members of their construction force. By doing this much time can be saved, and many mistakes avoided, due to ignorance of new men as to exact class of construction desired. With a similar standard in use in all

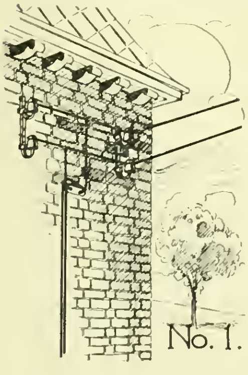


Plate 1.

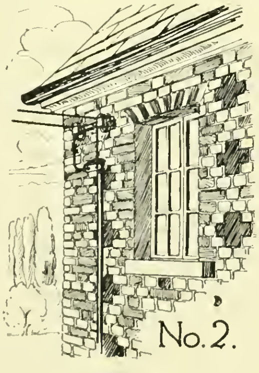


Plate 2.

sections, men coming into a new section will already know construction details.

Many of the fittings and methods illustrated are now standard with practically all member companies. All of them have either been in actual use for some years by one of our larger systems; or are re-designs of fittings that have shown defects and, under new design, these defects have been eliminated.

No claim is made as to the superiority of these fittings or methods over others which may be in use by member companies. They will, however, effectively and economically accomplish their purpose and your committee would urge

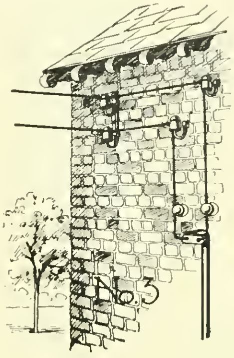


Plate 3.

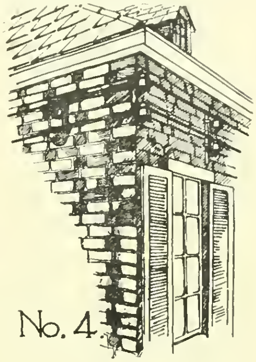


Plate 4.

upon member companies their use, if, in their judgment, they are better, or even as good, as those now used. By doing this many, if not all, of the fittings will shortly become standardized to the mutual benefit of the manufacturer, the jobber and the consumer.

This benefit would arise from lower manufacturing costs due to the demand being confined to one type of fitting, in place of, as at present many types all very similar; but differing enough to require duplication of equipment to produce, and excessive reserve stocks in order to give prompt delivery.

The jobber can afford to carry complete stocks of all fittings and handle them on a closer margin of profit, owing to possibility of a quicker turn over.

The consumer derives his benefit in being able to obtain from jobbers stock practically all fittings required; thereby effecting a considerable reduction in idle storeroom stock. He gets these fittings with minimum middleman's profit added, and with a manufacturers profit confined to that actually warranted by the production of the goods in large quantities from standard tools and equipment.

The drawings submitted cover broadly five sub-divisions of construction work.

1st.—Services.

2nd.—General distribution up to 4,000 volts.

3rd.—High tension distribution from 6,600 volts to 13,500 volts.

4th.—High tension transmission from 15,000 volts to 25,000 volts.

5th.—High tension transmission from 27,000 volts to 35,000 volts.

It should be noted that in working out these designs the same fittings are used on as many different classes of construction as possible, thereby reducing the standard stock to a minimum.

Particular attention is called to three features in their design. First: The effort that has been made to increase the useful life of our construction. All poles are treated at

ground line and other exposed parts with a preservative which has been proven to more than double the life of a pole. For a similar reason all wood arms are treated in order to get a life for them equal to that of the pole. Finally all exposed iron hardware is hot galvanized in order that its life may at least equal that of the other parts of the construction, and probably greatly exceed it. Galvanizing adds but

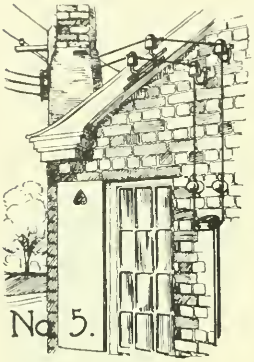


Plate 5.

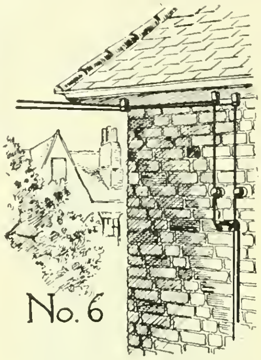


Plate 6.

about 20 per cent. to the cost of the hardware, which in itself is generally a small proportion of total cost of the line, generally not over 10 per cent. at most. To change hardware before the balance of line requires changing costs at least double what it did to first install it; and means interruption to our service while change is being made.

Second: In the design of pole framing the method of bracing has been considered very carefully from a mechanical standpoint. Under old methods we persistently violated one of the simplest mechanical rules in using a flat member to resist a large compression load. This has been responsible for most of pole framing failures in the past. A flat brace may resist normal strains for years and still be so close to the buckling point that a slight added load, such as sleet, will result in failure of an entire line. If a brace buckles to the slightest extent we convert our arm into a lever with the through bolt as the fulcrum and the opposite brace as the fixed anchorage, under tension. The natural result is the breaking of the arm opposite the gain.

In the suggested designs of framing no brace is allowed

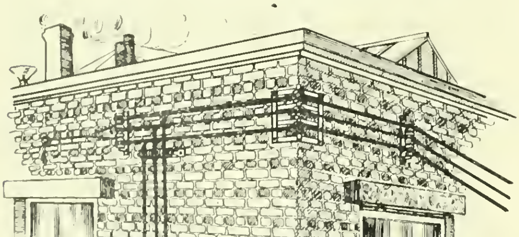


Plate 7.

under compression for use on any arm longer than 4-pin standard, or No. 2, 5 ft. 7 ins. For all arms above this size the flat brace is either under tension; or it is done away with and an angle iron brace substituted.

Third: The use of pine with wood shanks has been entirely abandoned. Metal pins make this feature of our construction as strong as the other component parts, in place of the weakest. Having a smaller pin hole in the arm also adds at least 30 per cent to the strength of the arm, and in addition, slightly decreases its manufacturing cost.

The metal pins suggested for use are either of the form having a wooden thimble, or of the spring thread type; thereby doing away with any possibility of insulator breakage due to difference in expansion, as is the case with solid metal pins.

Aside from these radical changes in suggested design or application the drawings will largely speak for themselves. Your committee have therefore confined the balance of the written report to brief descriptions of these drawings, as follows:—

Plates 1 to 8 inclusive show various types of service installations, using all metal service brackets. These brackets of various types and sizes being detailed more fully on Plates 9 and 10.

For attaching to brick and masonry walls, use is made of small expansion bolts. These are expanded in holes drilled by a hammer drill which may be of two types. First, that having a removable steel point on a chuck and rod, upon which a "dumb bell" hammer head is arranged to slide; and, second, a rotating hammer drill about the size of an

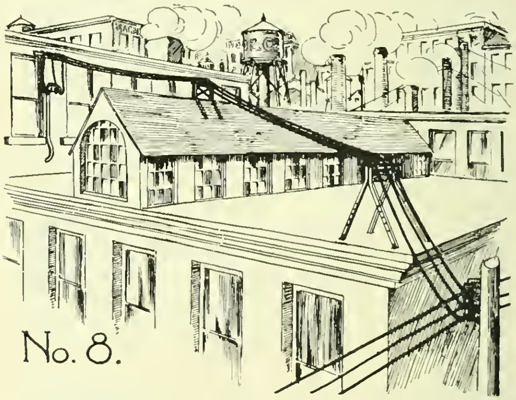


Plate 8.

ordinary breast drill. This strikes from 500 to 600 blows per minute on a steel drill point; allowing the drilling of hard brick walls as easily as drilling a wood plank. Plate 10 shows in detail the roof fixture, the application of which is shown in Fig. 8. This fitting fills a long-felt want as, while not particularly good practice to run services over roofs, this can not always be avoided. In the past it has been common practice to knock a roof trestle together from any available material on the job; and most of them look the part. The cost of this fixture will run between five and six dollars or probably less than a really good wooden fixture can be properly constructed for.

Plate 11 shows a composite pole giving proper spacing for framing, stepping, etc., to conform to use of fittings detailed. This illustrates the use of angle braces on six-pin arm, where the strain is one of compression. Also the vertical trussed brace between six-pin arms. This brace consists of two flat members trussed in centre with a bolt and spacer, giving a very stiff form of construction at minimum cost. The clearance brace over reverse arm shows the application of same fitting to more than one purpose, this being one of the trussed braces which are regularly punched with an extra hole for this purpose.

The three forms of metal shank pin are here shown applied. Also a guard iron for use where a slight angle occurs

in line, and where failure of a pin or tie might result in allowing the wire to leave the arm. This guard iron requires but one extra hole and bolt for its attachment.

Proper spacing of steps and pole sockets are also given. These spacings being those which experience has shown to be the best to suit the average lineman. It is recommended that all poles be so stepped and socketed, especially in urban and semi-urban districts as the convenience and improved appearance of the pole amply justifies the slight additional

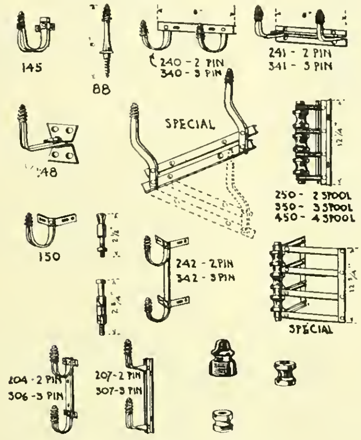


Plate 9.—Service brackets.

expense. The pole socket is particularly desirable where much climbing is necessary, as it does away with the older type of cleat step which permits anyone, particularly children, to climb the pole. A hole bored in the pole does not fill the requirement as it wears downward and allows the climbing pins to drop below horizontal so that a firm foothold can not be obtained.

The proper method of treating butts is shown. This gives the greatest service at minimum expense. For this treatment "Avenarius Carbolinium" is suggested owing to its having proven its value. If other preservatives of proven equal value, or better, can be obtained there is no objection to their use. In applying this to a pole the first coat should be very hot and second coat cold. Gains and pole roofs should also be painted with this compound.

When it is considered that, by actual test, the life of a pole can be doubled, with indications of its being tripled, by this process at a cost not exceeding fifty cents, its value can not be disputed.

Plate 12 shows a substantial method of framing for transformer support. The drawing shows full framing for a large transformer. For medium size units the upper angle brace is omitted, and for very small units use is made of ordinary short braces. These arms are double in both cases, the rear set being fitted with ordinary short braces. The purpose of the upper double arm being to keep the primary fuse block away from transformer hangers; and that of lower arm to provide an insulated standing point for the lineman replacing a fuse.

The secondary wiring and secondary fuse block is also clearly shown here, illustrating the clear cut and neat arrangement possible with these fittings.

The primary drop wires also show the clear and safe method of construction made possible. The upper sketch shows the unusually neat method of taking off a transformer drop where the "common neutral system" is used.

The sketch to the right shows the method of bringing a high tension ground wire down a pole upon which primary lines of 2,300 to 4,000 volts are run. This gives a good degree of insulation at, and for some distance from, the point where a workman must stand to work on live primary lines. This method of construction should very greatly decrease the number of fatal accidents which result from having a ground wire attached directly to a wooden pole on which live high tension work must be carried out.

Plate 13 shows details of the secondary fuse block and cleat bracket used in connection with transformer secondaries. The metal part of bracket is used either as a cleat rack or as a mounting bracket for the fuse block. The bracket is also used in other places where it is necessary to run a low tension jumper between different levels separated more than two or three feet.

The fuses used in this block are punched from thin sheet copper and therefore unaffected by the weather. The three strips in multiple permit of getting three sizes of fuse from a common stamping; so that in most systems but one type of fuse is necessary to meet all requirements of various sized transformer units.

Plate 14 shows the three arms used in connection with all voltages between 750 and 13,500. Voltages up to 600 are confined to bracket construction exclusively, where the vertical arrangement and close spacing gives a great gain in both construction, economy and general appearance of the line. At these low voltages a double thickness of weatherproof insulation can be depended upon, so that accidental actual contact of two lines rarely results in a breakdown.

The arms detailed follow closely the N. E. L. A. specification, excepting the small hole required for metal pins, and additional holes in No. 3 arm required for angle braces and high tension brace. The flat top is a distinct improvement over the old type of arm in which no firm bearing for a pin base was possible. The bevel on both top edges is stopped opposite gain space in order that either face can be used against pole.

The stock spacing block will be found a distinct improvement and saving over the old method of cutting up a

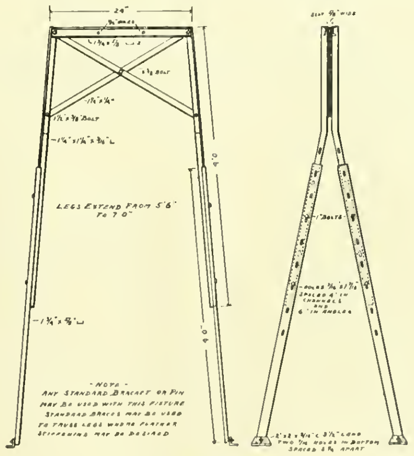


Plate 10.—Adjustable roof fixture.

more or less good arm to get a block, and then expecting a workman to bore a good true hole through end grain without a vice to hold it, and probably with a dull bit. These stock blocks will cut three average spacers with little waste.

These arms and blocks, in common with all other arms hereafter detailed are treated with two dipped coats of avenarius carbolinium. For this purpose a metal trough should be provided, so that a coke fire can be kept under it to keep carbolinium hot. The tank should be long enough

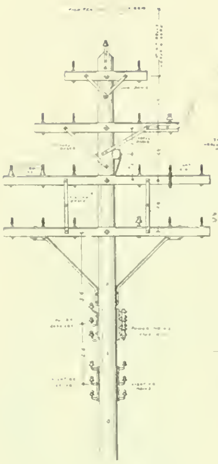


Plate 11.

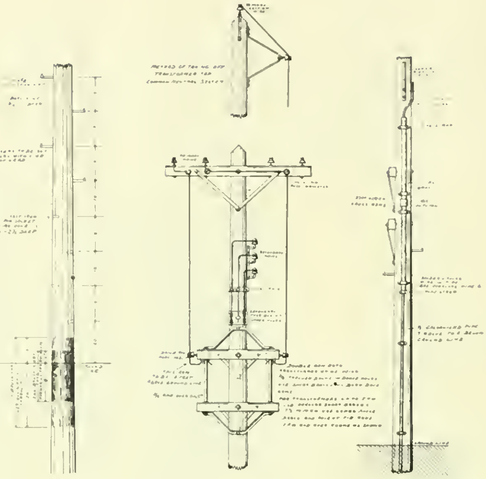


Plate 12.

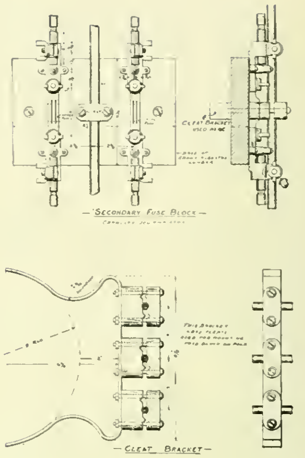


Plate 13.

to take the largest arm used, and should be provided with a slanting drainage board upon which arms can be allowed to rest for a few moments after dipping. This will save considerable compound which would otherwise be wasted.

Plate 15 shows details of pole hardware, most of which is self-explanatory.

The upper sketch shows standard brace as recommended by N. E. L. A. Next is shown the special trussed brace with its spreader tube, also the extra hole necessary to permit its use as a reverse arm brace. The short brace is used only with No. 1-2 pin arms.

The guard iron is shown in three lengths of strap, adapting it for use on any arm and for any voltage between 750 and 13,500. The ground wire bracket can be used singly for light ground wires, or in pairs for heavier wires or on angles. The upturned lip with groove prevents the ground wire becoming displaced should its fastening become loose. The outer edges of this groove or notch, should be slightly ground to a smooth radius before galvanizing, in order to avoid any possible chafing of the ground wire. For fastening the wire a lashing is made from a strand cut from the regular ground wire.

In plate 16 is shown at top a channel iron back brace, similar braces being shown later on for higher voltage construction. By the use of these braces double arming can frequently be avoided. Their use is principally where it is desired to prevent twisting of the arm. Where unusual pin strain is expected, or in making dead ends, double arms should always be used.

The remaining sketches show hardware required for transformer arm framing as previously described; also the common neutral bracket which can also be used for several other purposes. The pole top pin gives a very rigid construction and can be used for all cases where a top wire is required.

Plate 17 details the smaller class of hardware and is self-explanatory. The pole socket can be cast at any iron foundry from patterns gated in groups of four or five and requires no machining other than grinding off the gates.

Particular attention is called to the driving face on drive step. Steps made by simply bending over the round stock are very hard to drive straight and without bending. The slight saving in cost is lost many times over in labor wasted during installation.

Plate 18 schedules all machine bolts required in construction work. Particular attention should be paid to having good clear threads so that nut can be set up by hand. A bolt cut for use without galvanizing will not give good results if galvanized. Bolts should therefore be cut, with galvanizing in mind, at the bolt works.

Plate 19 shows a full line of insulators and pins required for any voltage within the range of this report. They are all standard and easily obtainable. The high tension insulators are designed to give good service both electrically and mechanically at minimum first cost. Being attached to screw pins of a type allowing for expansion, all troubles arising from having metal within porcelain or glass are overcome.

Plate 20 shows a full line of guy wire fittings which have proven their utility from practical application. The

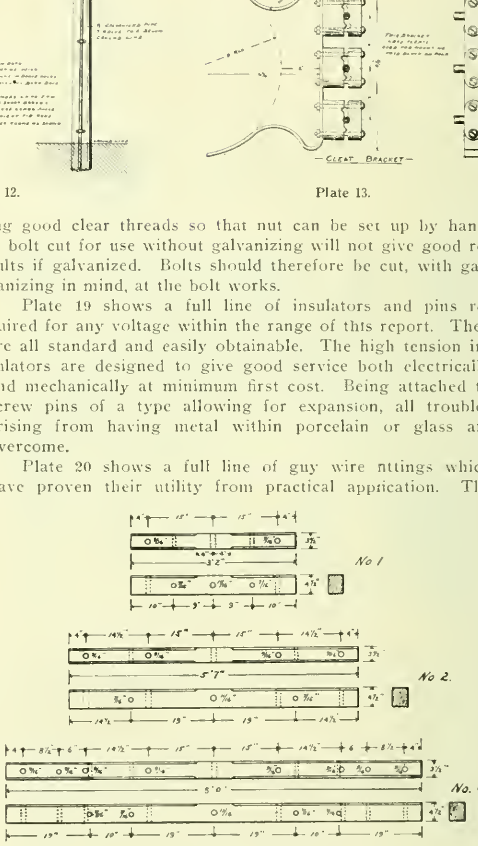


Plate 14.—Low and medium tension cross-arms.

porcelain insulator is much cheaper than the older type of strain and has the great advantage that its probable electrical condition is visible to the eye, which was far from the case with the older type of built-up metal and composition strains.

The guy wire shim is a simple little fitting which saves weakening the pole by having a heavy guy cut into it. Unlike other shims it carries its nails with it.

The boltless guy clamps will be found much preferable to older bolted type, being a great saver of time, temper and teeth.

The screw anchors will be found to give good service in sandy soil or loam, but cannot be used, of course in rocky

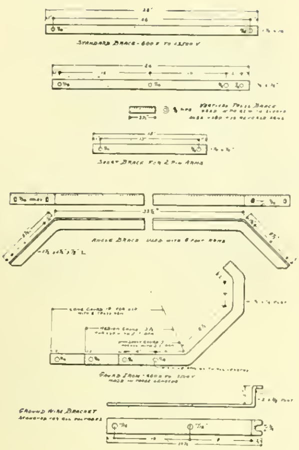


Plate 15.

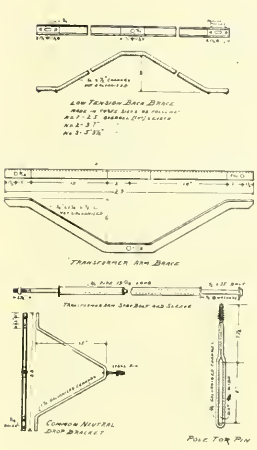


Plate 16.

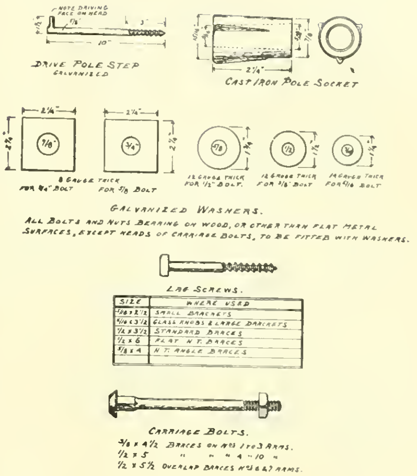


Plate 17.

or stony soil, in which case the old form of anchor rod and dead man must be continued.

The anchor guard is a very neat and inexpensive fitting and far superior to any split moulding protection, as well as being practically everlasting. These should be used whereever the public are likely to come in contact with anchor guys. Unprotected guys have led to many damage suits, but a guard 2½ inches in diameter should be visible to anyone with ordinary eyesight.

Plate 21 illustrates various forms of dead ending insulators and clevises. With these almost any possible combination, for any voltage can be made; thereby making it easy to properly dead end without attempting to rely on line pins which were never intended to withstand such strains, and, consequently, frequently failed at inopportune times.

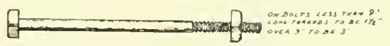
The Dossert dead ending fitting is particularly convenient and neat for heavy feeder work. These connections will hold well beyond the tensile strength of the cable. The insulators can be made up in tandem, by simple couplings, to withstand any voltage.

Plate 22 tabulates all wires necessary in construction work. Up to 6,600 volts double braid weatherproof insulation is recommended; the sizes given cover a sufficient range to meet all commercial conditions and by limiting standard stock to these sizes idle investment can be kept to a minimum. In urban or semi-urban districts no size smaller than No. 4 B & S should be used except for services or very small low tension extensions. In suburban sections or on private right-of-way one can take greater chances of having a wire break and in such cases reliability of service governs rather more than the requirement of public safety.

Above 6,600 volts bare wire should be used, as insulation is of no value and a bare wire is generally recognized as carrying high voltage. In selecting these sizes preference has been given to standard size strands rather than to standard total cross-section. This means quicker delivery in many cases, and makes the wire easier to identify. The resulting cross-sections give a range of sizes sufficiently close to meet all ordinary requirements.

In wire for guard or ground wire use, the same scheme of sizes has been given, using the B. W. G. gauge. For transmission work copper clad wire is recommended in preference to galvanized owing to its assured longer life and greater carrying capacity; the latter requirement being particularly desirable in grounded neutral systems. With a copper transmission line the life of the wire is practically infinite and our ground wire should if possible have equal life. Copper clad wire should however, not be confused with "copper coated" wire, which is simply copper plated. The copper clad is drawn over the steel core right from the bar down and is to all intents and purposes a composite metal conductor.

For guying the usual sizes of 7-strand, galvanized steel are indicated. Care should be used to specify soft steel in ordering, otherwise you will probably get steel as hard as



Galvanized Machine Bolts.

Nuts must run free with finger twist. This requires a die slightly below, and tap slightly above, standard. Recutting with standard smooth tap and die, after galvanizing, to roll threads clear.

Size of Bolt		How and Where Used
Single Arm	Double Arm	
⅜ x 4½		Tie bolt on vertical trussed braces
	⅜ x 14"	Combination brace and spacing bolt for Nos 1, 2 and 3 Arms
	⅜ x 15"	" " " " " " " 1, 2 " 3 "
	⅜ x 16"	" " " " " " 1, 2 " 3 "
	⅜ x 17"	" " " " " " " 1, 2 " 3
½ x 6"		Angle braces No 3 arm, and ground wire clamp No 1 arm
½ x 9"		Transformer braces and pole brackets
½ x 10"		" " " " "
½ x 11"		" " " " "
½ x 12"		" " " " "
	½ x 14"	Spacing bolts Nos 1, 2, and 3 arms. Combination brace and spacing bolt on Nos 4 to 10 H. T. arms.
	½ x 15"	" " " " " "
	½ x 16	" " " " " "
	½ x 17"	" " " " " "
⅝ x 6		Angle braces Nos 7, 8, 9 and 10 arms
⅝ x 7"		Ground wire clamp No 4 arm
⅝ x 12"		Through bolts Nos 1, 2, and 3 arms
⅝ x 13"		" " " 1, 2 " 3 "
⅝ x 14"		" " " 1, 2 " 3 "
	⅝ x 14	" " " 1, 2 " 3 " Dead ending bolts all arms
	⅝ x 15"	" " " 1, 2 " 3 " " " " " "
	⅝ x 16"	" " " 1, 2 " 3 " " " " " "
	⅝ x 17	" " " 1, 2 " 3 " " " " "
¾ x 12	¾ x 15	Through bolts high tension arms 4 to 10
¾ x 13"	¾ x 16"	" " " " " 4 " 10
¾ x 14"	¾ x 17"	" " " " " 4 " 10

Plate 18.

Siemens Martins, which cannot be worked to advantage for use in making up guys, even with clamps. The next nine plates (plates 23 to 31 inclusive) detail various framing arrangements for the three ranges of high tension: First, 6,600 to 13,500 volts; second, 15,000 to 25,000 volts; and finally, 27,000 to 35,000 volts. In each series three styles of framing are shown, explanation of one series covering the others.

At the lower voltage use is made of same standard arm

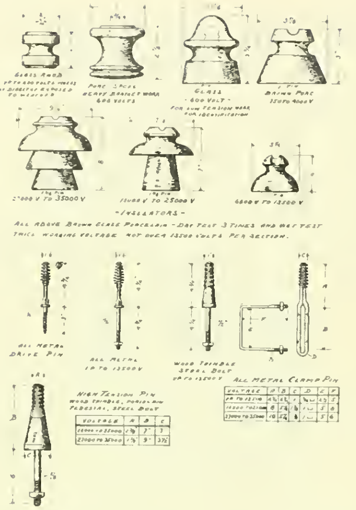


Plate 19.—Pins.

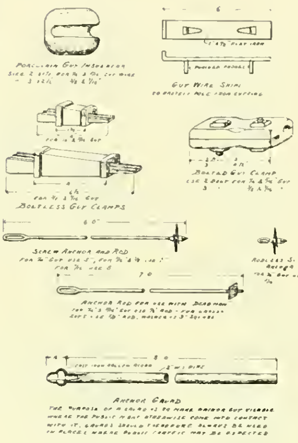


Plate 20.—Guy wire fittings.

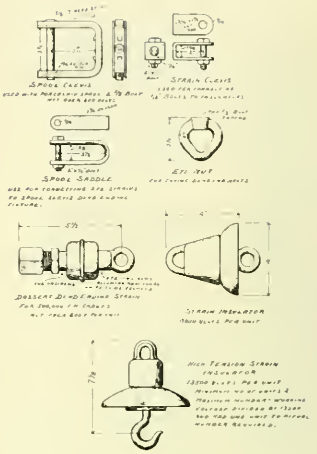


Plate 21.—Dead end fittings.

as used for ordinary distribution from 750 to 4,000 volts. Above 13,500 volts the larger high tension arms are specified.

At 13,500 volts and below, the pins are left ungrounded, as under ordinary conditions serious burning of the arm will not follow immediately a defective insulator. In many cases a circuit can be continued in operation until such time as it can be conveniently cut out. At the higher voltages a defective insulator is almost sure to burn off the arm if pin is not grounded. For this reason suitable grounding straps are indicated for all pins in the two higher classes of framing.

In all these systems of framing it will be noted that all braces under compression are of angle section; all under tension being of usual flat type. It will also be noted that all flat braces, in all classes of construction, are shown on face of the arm. This materially strengthens the arm to resist twisting strains and is much better, mechanically, than placing them on the back as is frequently done.

The angle braces are lagged to side of pole in place of to face as is quite common practice. If lagged to face we get one half of our pole under compression, and the other under tension, losing fully one-half its power to resist bending strains due to unbalanced loads. Lag screws are used for pole end of these braces as there is little if any outward pull, and no ordinary lineman can bore a hole true enough to register with holes in both pair of braces.

In the double triangle arrangement there are a few advantages but many disadvantages. It was formerly supposed that we must stick to this circuit arrangement; this has since been proven to be a fallacy. With this arrangement we get a very long and unstable lower arm and leave too little climbing space for a man between pole pins on the lower arm.

To correct these defects the type of framing which we call the "safety" arrangement has been developed. This is a slight departure from the ordinary features which amply warrant its very slight additional installation cost.

From the safety standpoint a workman can work on one circuit without having occasion to go anywhere near striking distance of the other. At all times he is working within a grounded shield and absolutely protected except from the wire upon which he may be working. By attaching a grounding jumper to the brace framing and to this wire he is assured of safety unedr all possible conditions.

From a mechanical standpoint this type of framing is ideal in that it forms a double truss with members under proper strain to suit their section; being therefore practically unbreakable.

From an electrical standpoint there are numerous advantages due to the perfect electrostatic shield provided for every wire of the two circuits. In the event of a flash-over the power arc is not held down under the insulator until it burns it up; but immediately follows the brace and finally breaks across the horn gap formed by the conductor and the brace. A further development is perhaps possible in this type of construction by placing an auxiliary horn tip around the neck of the insulator and bringing it up near the brace; but just a trifle less gap than the flash-over distance of the insulator. This would absolutely protect our insulators from the power arc following a flash-over; but might introduce other complications which could only be definitely determined by a try out.

The single circuit framing arrangement we believe is particularly desirable in those cases where there is a probability of having to convert to a double circuit line at some future date. This type of framing is identical with the double circuit safety framing, excepting that tower arm and

STANDARD WIRE.

SIZE	AREA-C.M.	METAL	FINISH	INSULATION	CLASS OF CONSTRUCTION ON WHICH USED.
No 8 B&S	16510	98% Copper	Medium Hard	Double Braid W.P.	On Service Work Only
No 6 "	26250	" "	" "	" " "	For General use up to 6600 Volts—in Suburban work only.
No 4 "	41740	" "	" "	" " "	" " " " " " "
No 1 "	83690	" "	" "	" " "	" " " " " " "
No 2/0 "	133100	" "	" "	" " "	" " " " " " "
No. 4/0 "	211600	" "	" "	" " "	For Heavy Construction up to 6600V—Excluding Services
500,000 C.M.	500000	" "	37 Strand Medium Hard	" " "	" " " " " " Including Services
No 2/0 B&S Str	133100	" "	19 " "	" " "	For Heavy Service Work Only [Solid wire of this size not suitable for short span work.]
No 4/0	211600	" "	19 " "	" " "	" " " " " " " " "
No 4 B&S	41740	" "	Medium Hard	Bare	Light Transmission through Suburban Districts
7 No 12 B&S Str	45710	" "	7 Strand Medium Hard	"	Transmission Line Wires All Voltages Above 6600
7 - 10 " "	72660	" "	7 " "	"	" " " " " "
7 - 8 " "	115570	" "	7 " "	"	" " " " " "
7 - 6 " "	183750	" "	7 " "	"	" " " " " "
7 - 4 " "	292140	" "	7 " "	"	" " " " " "
No 8 B.W.G.	27225	Mild Steel	Copper Clad	"	Transmission Ground W as Light Suburban Construction.
7 No 14 B.W.G.	48363	" "	Galvanized or Copper Clad	"	" " " Copper clad wire is recommended
7 No 12 B.W.G.	83167	" "		"	" " " owing to its lasting qualities and
7 No 10 B.W.G.	135692	" "	" " "	"	" " " ability to carry heavy currents. Particularly desirable on star systems
1/4" Strand		Soft Steel	Galvanized	"	Light Guying
5/16" "		" "	"	"	Ordinary Guying
3/8" "		"	"	"	Heavy Guying
7/16" "		" "	"		" "

Plate 22.

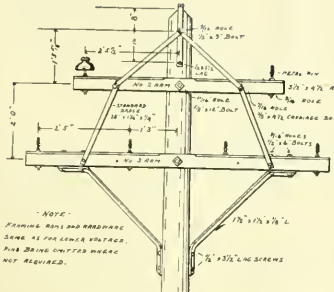


Plate 23.

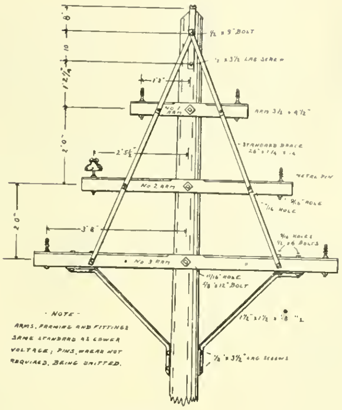
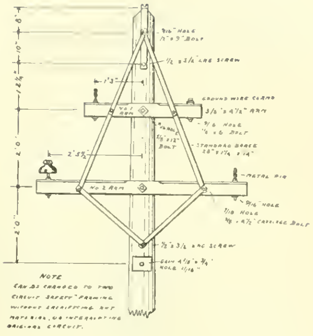


Plate 24.



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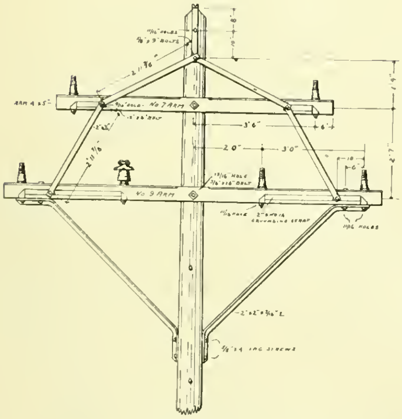


Plate 26.

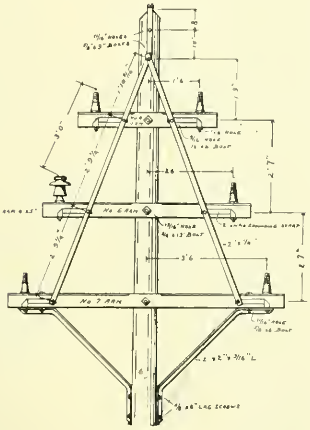


Plate 27.

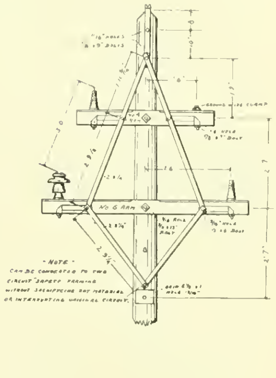


Plate 28.

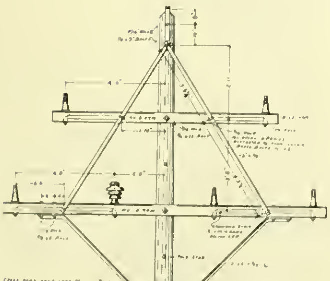


Plate 29.

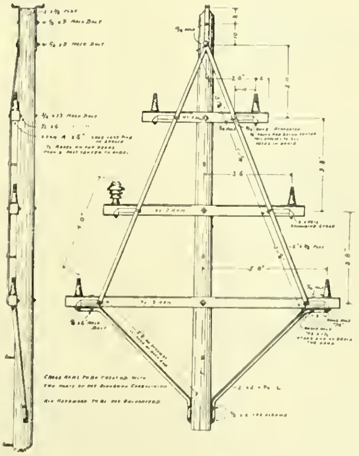


Plate 30.

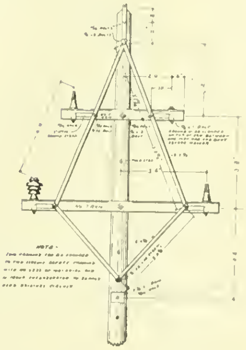


Plate 31.

fittings are omitted and flat braces are cut into two sections and lower pieces used for bottom braces.

The ground wire is clamped to end of upper arm in order to get it more nearly in the centre of the system, both from a mechanical and an electrostatic standpoint.

In the event of an extra circuit being necessary the

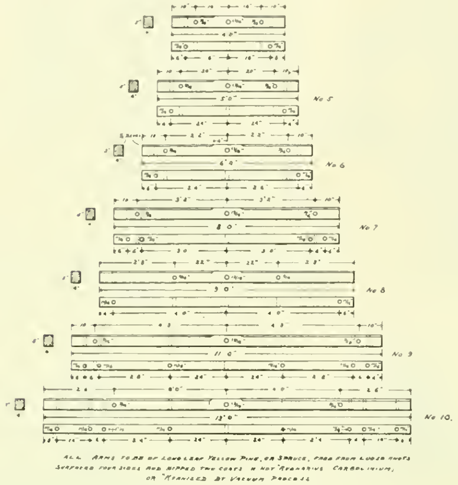


Plate 32.—High tension cross arms.

lower arm can be installed and braces previously used for arm above swung down to permanent position. The wires on new lower arm can then be strung and circuit transferred to its permanent position on this side of the pole. Ground wire then moved up to bracket at top of pole and the

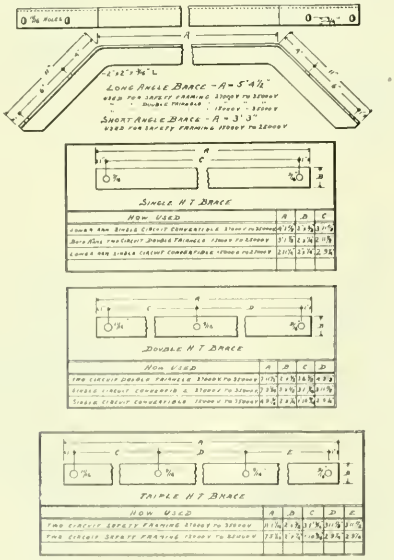


Plate 33.—Details of high tension hardware.

final wire of second circuit strung in its former position. These changes can all be carried out without sacrificing any of the original material and with but one trifling interruption to the former single circuit—that necessary to transfer its one-phase wire from the end of final middle arm to opposite end of new lower arm.

This "safety" triangle has one advantage in that a wire slipping a tie due to unequal ice loading, or being set into vertical oscillation following dropping of ice in patches, can not possibly come in contact with the wire above it, due to

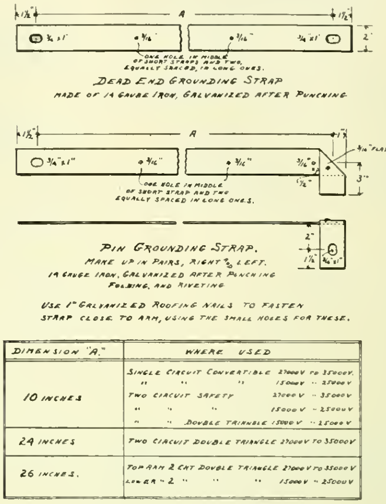


Plate 34.—High tension grounding straps.

the offset spacing being greater than the striking distance of the voltage. This is one of the points where failures in straight vertical framing have occurred.

In spacing poles with the circuit spacing herein provided the following span lengths should not be exceeded:—

6,600 to 13,500 volts	135 feet
15,000 to 25,000 volts	150 feet
27,000 to 35,000 volts	200 feet

With these span lengths and wires pulled up to proper

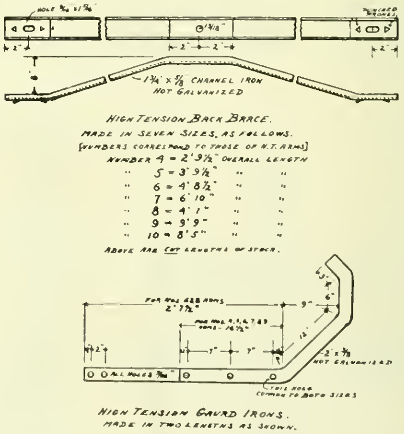


Plate 35.—High tension guard irons.

tension the lines can not swing within striking distance with temperatures up to 100 degrees.

The remaining plates, 32 to 35 inclusive, cover details of hardware for this high tension framing, and not previously shown.

(Concluded on page 63.)

Present Status of Prime Movers

A Very Valuable Report on the Latest Developments—Summary of Investment and Fuel Costs

By H. G. Stott, R. J. S. Pigott and W. S. Gorsuch

The Committee on Prime Movers has selected the following subdivisions of its subject, in order to cover the most important recent developments in the field of prime movers:

1. Reciprocating steam engine
2. Steam turbine
3. Gas engine
4. Oil engine
5. Hydraulic turbine
6. Finance and economics.

In order to show the present status of the art in a graphic manner, practically all of the data obtained have been plotted in curves which appear in the appropriate place in the text.

Reciprocating Engine

The reciprocating steam engine has, during the past five years, become practically obsolete for use in modern power stations. In the large new central station this engine is not even considered; but in small isolated stations it is still used to a considerable extent, especially where heating service is also handled. In small sizes, the engine still has some advantage in economy over the small turbine, but the margin is getting continually smaller; some of the latest geared units being almost on equal terms. The non-condensing and bleeder turbines have offered a satisfactory substitute for the engine on heating service; the continuance of the engine in use is therefore chiefly due to the apparent inability of purchasers for isolated plants to realize that economy of steam is only one of the items constituting cost of power. The superior reliability, low maintenance, sustained original economy, and low attendance cost of the turbine generally overbalance the rather doubtful advantage in original economy of the small reciprocating engine.

Steam Turbine

The steam turbine is now at the head of the list of prime movers. The items of comparison with other prime movers are:

(a) Capacity
(b) Efficiency
(c) Weight
(d) Price.

Capacity and Efficiency.—Usually the figure quoted as the measure of efficiency is the water rate or steam consumption per kilowatt hour. Hardly any measure can be selected which is less satisfactory, since, unless the steam and vacuum conditions are stated, the water rate means nothing. Two turbines of exactly equal merits may be quoted as having very different water rates if one is operated on superheated steam with high vacuum, and the other wet steam and lower vacuum. To fix the merits of the design, a knowledge of the efficiency ratio (Rankine cycle) is necessary; and to fix the thermal efficiency, a knowledge of the steam conditions is needed—in other words, the heat drop available.

The water rate of a perfect Rankine-cycle engine is given as 3,415 divided by the available adiabatic heat drop between initial and final conditions of the steam. Table I. gives a few values for the commoner conditions in use. The efficiency ratio is equal to the Rankine-cycle water rate divided by the actual water rate of the turbine. The thermal efficiency and the water rate are both dependent upon the steam conditions, and can never be correctly compared except upon the same basis of pressure, superheat and vacuum.

The efficiency ratio is a measure of the goodness of the design, influenced somewhat by steam and vacuum conditions. The efficiency ratios of modern turbines differ much less from each other than the variation of water rates would lead one to suppose.

The efficiency ratio increases (a) with size, (b) with superheat, (c) with reduction of vacuum down to about 26 ins., (d) with reduction of pressure. Speed also effects efficiency ratio, either to increase or decrease it, depending upon the design and conditions. Thermal efficiency increases (c)

TABLE I.

Heat Drop and Water Rates for 100 Per Cent Rankine-Cycle Efficiency.

	Dry steam.						100 deg. superheat.						150 deg. superheat.					
Press.	28 in.		28.5 in.		29 in.		28 in.		28.5 in.		29 in.		28 in.		28.5 in.		29 in.	
	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.	H.D.	W.R.
lb. per sq. in.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.	B.t.u. per lb.	lb. per kw.
165	324	10.52	338	10.09	355	9.61	345	9.89	360	9.47	378	9.03	353	9.66	368	9.27	387	8.82
190	331	10.30	348	9.80	364	9.37	356	9.58	369	9.25	387	8.82	365	9.35	379	9.00	398	8.57
215	341	10.00	354	9.63	371	9.19	363	9.40	376	9.08	394	8.66	373	9.14	387	8.81	406	8.41
240	347	9.83	361	9.45	378	9.02	371	9.19	385	8.86	403	8.46	380	8.98	396	8.61	413	8.24
kg. per sq. cm.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.	cal. per kg.	kg. per kw.
11.59	180.0	4.78	187.8	4.58	197.1	4.36	191.5	4.48	199.9	4.30	209.8	4.09	196.0	4.38	204.5	4.21	214.8	4.00
13.36	183.8	4.67	193.1	4.45	202.1	4.25	197.8	4.34	204.8	4.19	211.5	4.01	202.5	4.24	210.5	4.08	221.0	3.89
15.10	189.2	4.53	196.3	4.38	206.0	4.17	201.5	4.27	208.8	4.12	218.5	3.93	207.2	4.14	215.0	4.00	225.2	3.82
16.87	193.7	4.43	200.5	4.29	209.8	4.10	206.0	4.17	213.5	4.03	224.0	3.84	211.6	4.07	219.8	3.91	229.5	3.75

with pressure, (f) with superheat, (g) with vacuum. It is evident that some of these conditions at least are incompatible with each other, and that the turbine having the best water rate may not have the highest efficiency ratio.

Fig. 1 shows water rates which may be obtained for various sizes of machines. For the standard conditions of 175 lbs. gage, 100 deg., superheat, 28½ ins. vacuum, the average value is that which will ordinarily be obtained for standard designs; but better or poorer rates may be obtained under special conditions, either of design for high efficiency, which increases cost, or of cheap construction, which usually means poor water rate.

Fig. 2 shows the Rankine-cycle efficiency ratios under the same conditions. For the same sizes of machine, 25-cycle generators will have the same water rate and efficiency ratios, as the variation in speed can be readily cared for without sacrifice of efficiency. The corrections for other steam and vacuum conditions must be applied to get the proper water rates—these differing somewhat for different types. The usual superheat correction is one per cent improvement in water rate for each 10 deg. superheat between saturation and 100 deg.; one per cent for each 12½ deg. superheat between 100 and 200 deg. superheat. The vacuum correction varies considerably with different machines, and

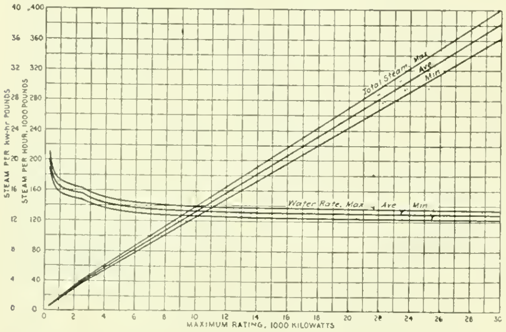


Fig. 1.

amounts to about 5 per cent improvement between 27 and 28 ins.; 6 per cent between 28 and 29 ins. A better method is to use the total heat drop available in each case as a ratio applied to the water rate. An important feature influencing cost is the matching of generator and turbine. In many cases the turbine has its best water rate at the maximum 24-hour rating of the generator. For many purposes this is undesirable. The best water rate should occur at from 75 to 85 per cent of the maximum 24-hour rating of the generator; in other words, the turbine should be smaller than the generator.

The overload devices (extra nozzles in the case of impulse turbines and by-passing in the reaction turbines) can be readily designed to take care of the loads up to 50 per cent in excess of the best water rate load in the turbine. The best water rate reached by the turbine occurs just before these overload devices operate; and it is for the steam flow at these loads that the turbine proportions are designed. When the effect of auxiliary steam consumption on the steam demand of the engine room is considered, it is evident that the under-sizing of the turbine to a small degree is desirable.

Weight.—The weight increases with the increase of vacuum, decrease of speed, decrease of initial pressure, and increase of efficiency ratio. The increase of vacuum obviously affects the weight by increasing the size of the exhaust end and the blading. Decrease of speed increases the weight, as it enlarges the dimensions in every direction for a given capacity, and sometimes increases the number of stages for a given efficiency. Increase of efficiency ratio usually implies sharper blade angles, more stages, and larger blading, which obviously increases the weight. Fig. 3 gives the total weight and weight per kilowatt under the standard conditions previously stated.

Cost.—The turbine design is usually a compromise between cost of manufacture and efficiency. The cost is influenced by steam conditions, speed, and by type, to some

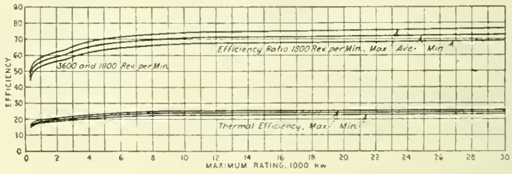


Fig. 2.

extent. Increased thermal efficiency means increased cost, as it means increased blade dimensions, stages, and exhaust openings for higher vacuum and in some cases altered construction to suit higher superheats.

Fig. 4 is cost per kilowatt and total cost for machines built to the standard conditions previously given, delivered and erected within 600 miles of factory. 25-cycle machines will cost from 15 per cent more, in smaller sizes, to 10 per cent more in the larger sizes. Cost per lb. (Fig. 5) remains about constant for any given capacity, so that this increase in cost for 25-cycle machines is readily explained, as the reduction in speed from 1,800 to 1,500 and from 3,600 to 3,000 revolutions raises the weight approximately in inverse proportion to the decrease in speed.

The three items which influence the purchasing of a turbine are price, water rate and time of delivery. The time of delivery cannot be much reduced beyond a certain point. There is, therefore, a very strong tendency to cut the price or the water rate in order to get the business where competition is very keen. As only about one turbine in every 50 sold is ever tested, the opportunity to manipulate the water rate of the turbine downward has often proved a stumbling block to good engineering. The cost to manufacture any of the standard makes is not very different. The prices ordinarily will therefore be about the same. The tendency to cut the water rate below what can actually be obtained can therefore only be checked by the engineer's watchfulness. Comparison with the Rankine efficiency ratio for any size machine is one of the safest means of detecting

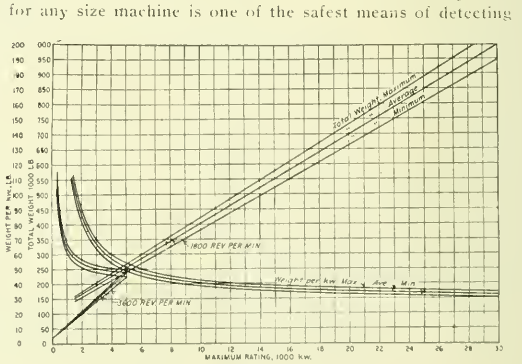


Fig. 3.

spurious water rates, since they will give impossible efficiency ratios.

Gas Engines

The fuel supply for the various classes of this type of prime mover is obtained either by the conversion of coal,

coke, lignite, peat, wood, oil or other kindred fuels into a gaseous product in a producer; or from natural resources, or the recovery of waste or by-product gases from blast furnaces and coke ovens. The utilization of natural gas and blast furnace gas has enabled a wide application of the gas engine, amounting to over 75 per cent of the total gas power machinery installed in the United States, the natural gas being in the lead as to aggregate capacity.

The development of large gas engines is largely due to the ideal conditions existing in steel industries where large

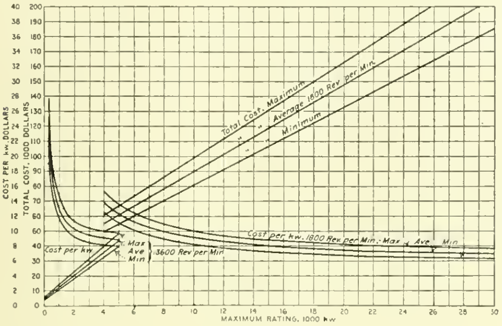


Fig. 4.

quantities of blast furnace gas are available, requiring only cleaning to make a perfect fuel for this type of prime mover. Blast-furnace-gas power plants have been especially striking owing to the magnitude of the engine, which has now reached a capacity of 6,000 brake horse-power for a single unit of the twin tandem type.

The main improvements in gas engines have been in the reinforcement of cylinder castings, simplicity of the cylinder, piston and rod construction, more efficient packing, adoption of the throttling governors, etc.

The rapid introduction of the gas-producer in the manufacture of gas from cheap grades of coal has given special impetus to the producer gas engine. Many of the low grades of fuel which are not fit for use under the steam boiler have been used with reasonable success in the producer.

There is now a growing demand for gas engines to operate with coke oven gas, and probably interesting developments may be expected along this line within the next few years.

With the universal tendency toward high-speed rotative machinery, engineers engaged in the development of internal combustion engines have recently shown renewed activity in substituting rotary for reciprocating motion. While much valuable information has been obtained, yet the practical

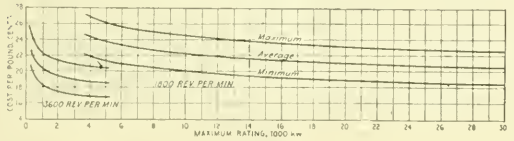


Fig. 5.

difficulties have not been surmounted and the gas turbine has not reached a commercial stage. However, if the gas turbine does come, it will probably revolutionize power production in large steel centres and wherever natural fuel oils abound in this country.

Capacity.—There are two general types of gas engines known as the two-cycle and four-cycle, or two-stroke and four-stroke, built with single or double-acting cylinders, either vertical or horizontal, the usual form in sizes above 200 brake horse-power consisting of two double-acting cylinders set tandem. By combining two such units we have the twin tandem type that is built in sizes as large as 6,000 brake horse-power. The four-cycle engine is the type that is almost always used in units of any appreciable size, and especially the double-acting four-cycle type with two cylinders arranged in tandem, which was brought to a commercial state about eleven years ago.

Steam turbine and engine ratings are usually such that they are worked under their most economical load at the rating of the electrical generator. With gas engines, on the other hand, the efficiency increases with the load beyond the capacity of the engine (see efficiency curve, Fig. 6), and for this reason the rating of the engine is generally made as nearly as possible to its maximum capacity, allowing from 10 to 20 per cent for overload.

The gas engine does not possess inherent capacity for overloads in the same sense in which the steam turbine and engine do, hence whatever overload it has, is allowed by the manufacturer. The maximum capacity of a gas engine is evidently reached when the cylinder has taken a full charge of mixture of the highest heat value and density, that is, containing the maximum B.t.u.'s per cu. ft. This being the case, it is evident that gas engines must accommodate themselves to variations in the quality of the gas. Assuming for illustration, that a 10 per cent overload is sufficient, an engine of 550 horse-power maximum capacity would then be rated at 500 horse-power.

The gas engine being fairly limited as to the power which may be produced in a single unit, there has developed on the part of some manufacturers a disposition to increase

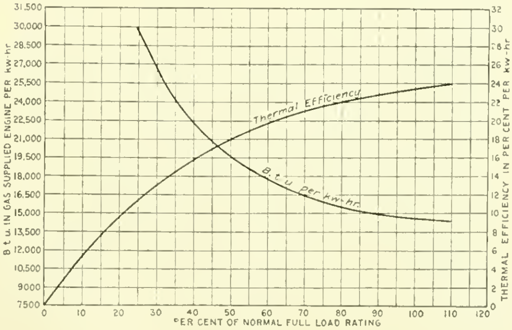


Fig. 6.

speeds. While high speeds have been used in steam turbine and engine practise, it should not be taken as a criterion in gas engine work, as the heavy masses involved in the reciprocating parts of the gas engine may become destructive and the result may be higher maintenance cost.

Efficiency.—One of the characteristics of the gas engine which other heat engines do not possess is that the thermal efficiency remains fairly uniform over all ranges of sizes.

Fig. 6 shows representative curves of thermal efficiency and rate of heat consumption per kilowatt generated for different percentages of normal full-load rating of large four-cycle producer and natural-gas engines, no allowance being made for auxiliaries.

Many figures have been given of the thermal efficiency of the gas engine which vary materially, but we believe that the curve above referred to gives conditions generally met within large gas engines, namely, 25.2 per cent. on the basis of brake horse-power, or 23.8 per cent on the basis of kilowatt-hours generated at full load rating. All curves of the gas and oil engines have been referred to the basis of kilo-

watt-hours generated so as to be comparable with the steam turbine and engine.

The range of fuel consumption as guaranteed by American manufacturers for their engines at full load rating with different fuels varies from 9,500 to 13,500 B.t.u. per brake h.p.-hr. (2,394 to 3,402 large calories) for producer gas, and 8,500 to 15,000 B.t.u. per brake h.p.-hr. (2,142 to 3,780 large calories) for natural gas, or reducing to basis of kw.h., 13,500 to 19,200 B.t.u. per kw.h. (3,402 to 4,838 large calories) for producer gas, and 12,200 to 21,400 B.t.u. per kw h. (3,074 to 5,393 large calories) for natural gas. Blast furnace gas runs in the neighborhood of 10,500 B.t.u. per brake h.p.-hr.

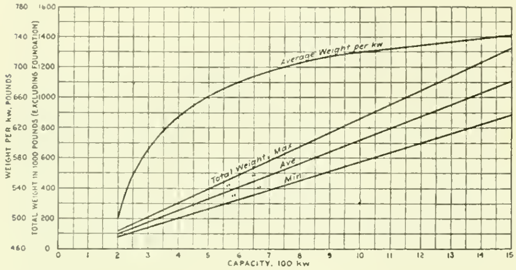


Fig. 7.

(2,648 large calories), or 15,000 B.t.u. per kw.h. (3,780 large calories) generated.

Weight.—The operation of the gas engine involves high temperatures and pressures suddenly applied to the working parts, consequently this class of prime mover is inherently massive.

The range in weights of the various sizes of horizontal type producer-gas and natural-gas, four-cycle single and double-acting tandem and twin-tandem gas engines, as manufactured by the largest gas engine companies in this country, are shown in Fig. 7.

These curves are drawn to include all capacities from 200 to 2,000 kw., and show that there is a variation of 20 per cent from the average weight. Considering the curve of average weight per kilowatt, one thing is basic, namely, that the big unit weighs more per kilowatt than the small unit. The reason is that as you go up in size and lengthen out the stroke the weight runs up per unit capacity. The weight is governed by many considerations, such as rotative speed, the mean effective pressure on which the builder figures his rating, the nearest size the builder has to fit a given generator, the question of single or double crank, etc.

Cost.—On account of the heavy parts made necessary by high temperatures and pressures, the gas engine is considerably more expensive to build than steam turbines or steam engines.

In some types of gas engines there is not very much difference between the cost per unit capacity in large and small sizes, whereas with other companies it varies considerably.

Fig. 8 shows the limits of total cost, average cost per kilowatt capacity, and average cost per pound, of the type and size of engine and generator as described in Fig. 7. The price is for engine and generator complete and installed exclusive of foundations within 600 miles of factory. It will be seen that the price varies 18 per cent from the average for the different types.

The cost of the gas engine is influenced by the same conditions that govern the weight, as explained above. The different combinations of stroke and synchronous speed result in varying piston speeds, and for a given power the price will be higher the lower the speed. Many attempts have been made to lower the cost of the gas engine by decreasing the weight without impairing its reliability, and to increase its capacity by increasing the pressure of the charge and simultaneous scavenging of the exhaust gases, but all without definite results.

Oil Engines

Oil engines have progressed rather slowly in this country, while in Europe the development has been more marked, especially since the expiration of the basic Diesel patents in 1912.

The Diesel engine is essentially a vertical type, but the last two years have witnessed a remarkable development of the horizontal type. While tests show that the fuel consumption is slightly higher than with the vertical type, nevertheless on account of the greater simplicity and better accessibility and lower cost, many manufacturers have launched out to build them.

There are approximately 300 installations of medium and heavy-duty oil engines, aggregating over 75,000 h.p., in operation in the United States.

On account of the very high cost of natural oils in countries that do not have an oil production of their own, the use of tar oil with a small addition of ignition oil in the Diesel engine is rapidly finding favor. Some oil engines operate satisfactorily on any fuel and especially the crude oils produced in this country, while others are limited to certain qualities. The recognition that coal is too valuable a fuel to be wasted in our present-day furnaces, is spreading, and much interest is being taken in the by-product coke oven and by-product gas producer plants, in hope that the production of tar oil, an artificial product, will aid to check the advance in price of natural liquid fuels. In this country the condition is different on account of the supply of rich natural oils, such as the light grades of crude oil produced in the eastern fields, as well as the heaviest grades produced by the California, Texas, Oklahoma and Mexican fields, which are largely asphalt base.

Capacity.—Similar to the gas engine, the oil engine does not possess an inherent overload capacity in the same sense that the steam turbine does, hence, whatever overload is required must be provided by the manufacturer.

The oil engine is restricted in size for the same reasons given in the case of gas engines. The largest Diesel engine operating in this country is a 450 brake horse-power double-unit vertical four-cycle three-cylinder type, whereas in Europe they have been built as large as 2,500 brake horse-power. There has recently been built in Germany a 2,000 brake horse-power horizontal double-acting, four-cycle,

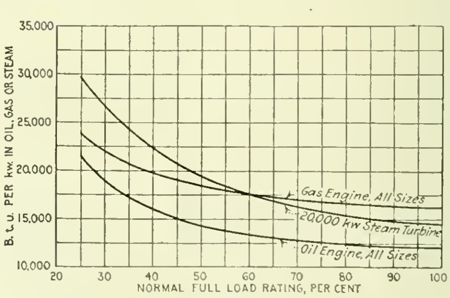


Fig. 8.

twin-tandem Diesel engine operating with tar oil, which promises interesting results.

Efficiency.—The thermal efficiency of the oil engine varies slightly with the capacity. Unlike the gas engine, the thermal efficiency does not increase with the load beyond the capacity of the engine.

Figures of efficiency have been given at different times that cannot be substantiated. With oil having 19,000 B.t.u's (4,788 large calories) per lb., the thermal efficiency and fuel consumption that may be expected at different percentages

of normal full load rating, no allowance being made for auxiliaries, are shown in Fig. 9.

At full load the fuel consumption is 0.64 lb. per kw.h. or 0.45 lb. per brake horse-power, and the thermal efficiency 28.2 per cent per kw.h., or 29.8 per cent per brake horse-power.

The fuel consumption of the best oil engines to-day, made in large sizes, varies from 0.40 to 0.50 lb. per brake

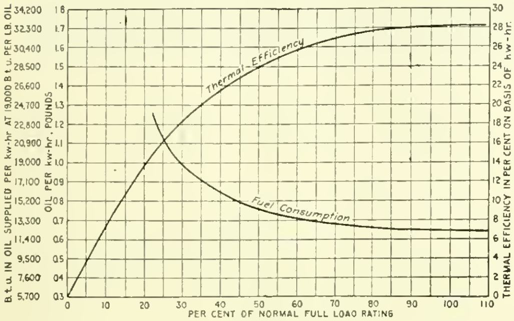


Fig. 9.

horse-power, the highest fuel economy being obtained by the four-cycle type.

Weight.—The Diesel engine is inherently massive for the same reason as the gas engine, namely, high temperatures and pressures, consequently the weight, including engine and generator per kilowatt capacity increases with the size, as shown in Fig. 10.

It will be seen that the increase in weight from 40 to 160 kw. capacity is very rapid, while with sizes larger than 160 kw. it is not so pronounced.

High-compression Diesel-cycle crude-oil engines of the two and four-cycle, single and twin-cylinder, horizontal type, using a heavy grade of crude oil, are now being manufactured in America as large as 500 h.p. capacity, some companies standing ready to construct units of 800 h.p. capacity

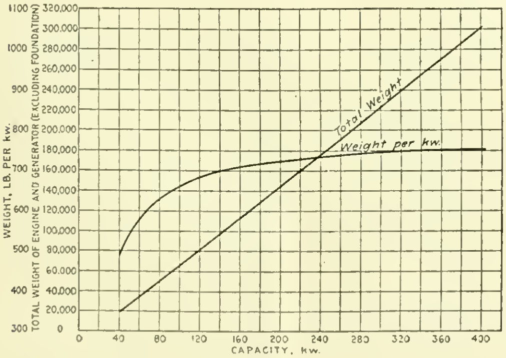


Fig. 10.

if required. Fig. 11 shows the average total weight and weight per kilowatt capacity for these machines.

Cost.—There have been so few oil engines driving generators of any appreciable size installed in this country that it is a difficult matter to tabulate any costs for comparative purposes with other prime movers. The most reliable figures available for the Diesel engine average approximately $95 per kilowatt installed, including engine and generator complete, but not the foundations, within 600 miles of factory. Fig. 12 gives the average total cost per kilowatt for all sizes at $95 per kw., also the cost per pound, which decreases but slightly for machines above 160 kw. capacity.

Important improvements in the construction of the vertical type Diesel engine are being made in this country, as well as in Europe, which will probably reduce the weight and consequently the unit cost.

The average total cost, average cost per kilowatt, and average cost per pound of two and four-cycle, horizontal, crude-oil engines, American manufacture, including engine and generator, are shown in Fig. 13, corresponding to the weights given in Fig. 11.

There is considerable variation in the weights and costs of the horizontal type oil engines of the different manufacturers, and for this reason the average curve is given instead of the maximum and minimum. The weights and costs are fairly consistent for the single cylinders of all sizes, the greatest difference being with the twin and four-cylinder types. These curves hold fairly well for the so-called semi-Diesel horizontal type.

Hydraulic Turbines

The development of hydro-electric power installations has created new demands on the designers and manufactur-
In early hydraulic installations, efficiency was frequently
ers of hydraulic turbines for betterments in efficiency, power,

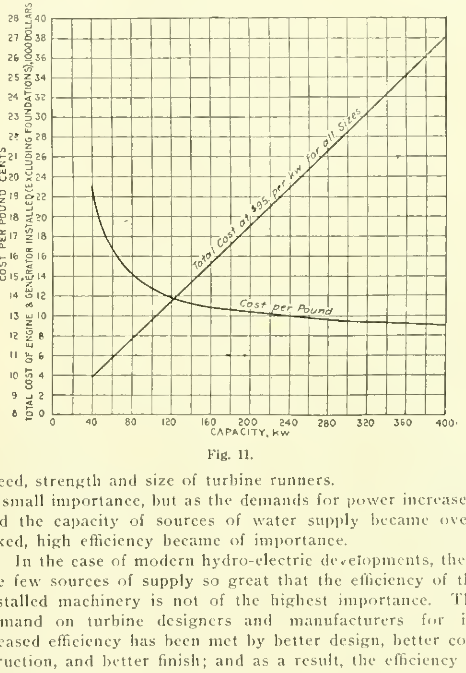


Fig. 11.

speed, strength and size of turbine runners.
of small importance, but as the demands for power increased, and the capacity of sources of water supply became overtaxed, high efficiency became of importance.

In the case of modern hydro-electric developments, there are few sources of supply so great that the efficiency of the installed machinery is not of the highest importance. The demand on turbine designers and manufacturers for increased efficiency has been met by better design, better construction, and better finish; and as a result, the efficiency of turbines has been so increased that in the case of at least four different manufacturers, efficiencies of 90 per cent or over have recently been obtained at the hydraulic testing flume at Holyoke under the best conditions of gate, speed and head; and high efficiencies can now be maintained through considerable variations both of head and power, as will be seen by reference to Fig. 14.

Recent tests at Holyoke on a high specific speed 28-in. vertical Francis type turbine, the results of which are shown in Fig. 15, represent the best that is being accomlpished at the present time.

It will be seen that the efficiency remains fairly constant through a considerable variation in power. The effi-

ciency at 90 per cent gate opening is 91.5 per cent and at full gate it dropped to 84 per cent.

For direct connection to comparatively high-speed electrical machinery, both capacity and speed, together with high efficiency, are common demands. A comparison of the power capacity of various types of wheels can best be made on the basis of the power of the unit wheels of the various types under the unit head. This unit power is represented by the equation

$$P_1 = \frac{P}{D^2\sqrt{h^3}}$$

P_1 is the unit power of the unit wheel of the type considered under unit head.

P is the power (h.p.) of any wheel under the head h

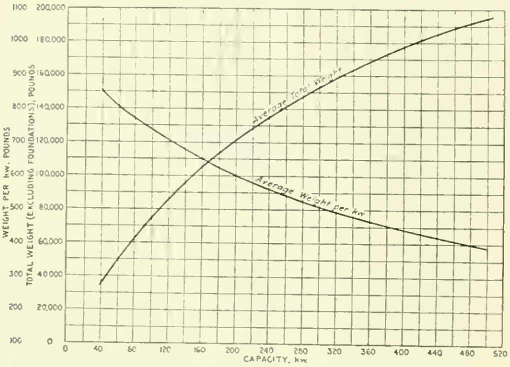


Fig. 12

D is the diameter in inches of the wheel considered,

h is the head in feet under which the power (P) is developed.

In each case the best conditions of speed and efficiency are assumed to obtain.

In the original Boyden-Fourneyron turbine of 1849, the value of P_1 was equal to 0.00032

This was increased by Swain in 1855 to ... 0.0008

By McCormick in 1860 to 0.0014

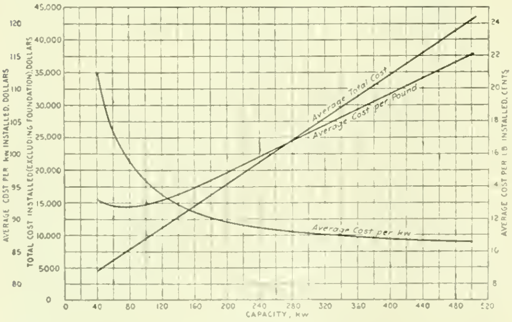


Fig. 13.

By a number of recent designers to values from ... ... 0.002 to 0.0024

And has been extended to 0.00388

in a recent design, without a reduction in efficiency below 87 per cent, an enormous increase in power which is quite worthy of note.

Capacity and speed are both often highly desirable for electric machinery if both can be extended without too great a sacrifice in efficiency. The combined capacity and speed may be compared by the speed power coefficients of the various types (see page 1409, Vol. XXXI., Transactions A.I.E.E.), which may be termed the "specific power" of the wheel, and which is represented by the equation

$$Ps = \frac{n^2P}{\sqrt{h^5}}$$

in which n = the revolutions per minute of the wheel under the head h and with the horse-power P. The speed power coefficient Ps. is the square of the coefficient of unity speed.

The value Ps = 10,000 had barely been reached in 1910, but during the present year a designer has succeeded in increasing the value to Ps = 11,800.

Such wheels are frequently of high value for low-head and high-speed conditions, but cannot maintain such high efficiencies under great ranges of head and loads as can be maintained with wheels of lower "specific power," such as are shown in Fig. 14.

Among the more recent improvements in the construction of hydraulic reaction turbine runners may be mentioned the construction of high-capacity runners of cast steel in single castings, thus giving great strength with large capacity under high heads to which such turbines could not previously be applied.

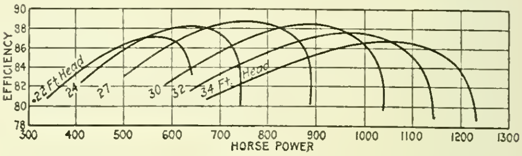


Fig. 14.

The recent successful construction of the large single reaction turbines for the Keokuk hydro-electric plant is also worthy of note. These turbines are 16 ft. 2 in. in diameter and operate at 57.7 revolutions per minute under a 32-ft. head. The runners weigh 73 tons each and develop 10,000 h.p. While greater power has previously been developed by single wheels under high heads, these wheels are remarkable for the amount of power developed under the low head utilized.

Since 1911, the trend has been toward the adoption of the single-runner, vertical-shaft turbine for low and medium heads. This change in type of unit is due to the recent progress in the design and development of high-capacity runners also the improvement in thrust bearings.

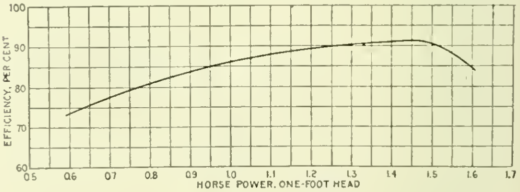


Fig. 15.

Prior to this time, the majority of turbines for low and medium heads were either of the vertical-shaft, multi-runner type, or of the horizontal-shaft, multi-runner type.

Weight and Cost.—The weights and costs of hydraulic prime movers are not strictly comparable with the steam turbine, gas and oil engines, for in the case of the thermodynamic prime movers, the conditions are more or less fixed and the costs relatively uniform, whereas with the water turbine they vary between fairly wide limits, depending upon the conditions under which they are to be operated. The head, kind of flume, open or closed, setting vertical or hori-

(Concluded in Aug. 15 issue.)

Electric Railways

Employees' Accident Insurance

Traction companies are particularly interested in the subject of accidents and workmen's compensation. It is doubtless for this reason that railway companies, both steam and electric, have been quick to see the advantage of the Safety First movement and have, by every means in their power, furthered attempts to reduce accidents and fatalities on or adjacent to their lines of traffic. The Workmen's Compensation Act which is about to be set in motion in Ontario will depend for its smooth administration very largely on the extent to which the Safety First movement has developed and its teaching taken to heart by the average employee. In parts of the United States a very similar condition exists and it is interesting to note that the railway companies are making the administration of the act as easy as possible and are even taking steps in advance to provide for its amicable and effective working. In this connection an interesting paper was read by Mr. Jas. H. Hoey, second deputy superintendent of insurance of the State of New York, before the annual meeting of the New York Electric Railway Association. This paper speaks of a number of instances where remarkable progress has been made in furthering friendly relationship between employer and employee through co-operation and better understanding. An abstract of this paper follows:—

The Workmen's compensation law in the State of New York provides not only for damages on account of injuries but also for medical service for injured employees during the time of disability. It is refreshing to see that the great organization with which your president, Mr. Hedley, is identified has taken the initiative by providing in advance for this important service. The Interborough Rapid Transit Company has arranged with doctors and hospitals for the care of its injured employees. It has also worked out a scheme which bears the earmarks of care and study. When a man is injured he reports at once to the first-aid man, a fellow employee, at a terminal shop or power house. It is this man's duty to give the proper first-aid treatment, and then send the injured man either to a local doctor or, if the injury is trivial, back to his work. If further treatment is needed, the employee continues to visit the doctor as often as necessary, and if necessity arises he is sent to a hospital. In the hospital he does not become an ordinary ward patient but is sent to the semi-private ward where he can see friends and relatives at reasonable times and where he does not have to incur the stigma that attaches to a charity patient. If his injury requires special treatment, he will obtain the services of a specialist. At the central hospital massage, baths, electricity and the like will be provided to treat those who have become victims of rheumatism or other ills common to the workman who is exposed to the weather. All these go to make a strong link in the magnificent scheme for the conservation of human life.

The country is now entering on an era of economic conservation of life and property. Yet while science has been searching out and destroying the older enemies of man, invention has not provided safety appliances to keep pace with its own creations. Every man injured by a railroad and improperly compensated becomes an agent of discontent among his fellow men, with whom the railroads in the last analysis will have to reckon. Every inadequate piece of rolling stock becomes a piece of evidence in the indictment against efficiency. Every unprotected mile of roadbed makes for the propagation of the spirit of ill-will towards the company that maintains it.

To accomplish safety, to bring it to its highest state of perfection, organization is needed. The schools also must be utilized, and the young people taught what to do and how to do it in order to protect themselves. Yet a higher duty devolves upon the railroads, a duty which must find its practical expression in the adoption of the most up-to-date methods of safeguarding life and limb.

The disposition of woman, for example, to use her right hand in alighting from a street car cannot be corrected in a day. You cannot correct this disposition by any number of educational pictures. The trouble is too deep for such a superficial remedy. The evil can only be obviated by providing a means which makes the use of the right hand under the circumstances unnecessary or impossible, and by instituting a radical and thorough system of education. You can begin with the young girl in school. You can train her to acquire proper habits; you can teach her how to use her hands in order to protect herself. But the process of education has to be undertaken before the habit predicated on a natural tendency is acquired.

The most necessary of all educational work, however, is the education of your own employees. Every motorman, every conductor, every trainman is familiar with the causes of accidents. Many of them have worked out in their own minds methods by which these accidents should be avoided. Experts tell us that only 15 or 20 per cent of the accidents caused by machinery can be prevented by the adoption of mechanical appliances. It follows, therefore, that if we are to cut the number of accidents in half, the remaining 30 or 35 per cent must be prevented by means of education.

In the old days conductors and other employees of railways received bonuses based on the amount of their collections and the time made on each trip, and more recently they were rewarded for their economic use of electricity. In the future they will get rewards for minimizing the number of accidents. Such a system has been established by the United States Steel Corporation and remarkable results have flowed from it. Each mechanic is given to understand that every scheme of safety he invents to make the operation of his own machine safer is going to be recognized by the payment of periodic bonuses for the prevention of accidents. This is a plan which steam railroads and electric railways can copy with advantage.

Safety is going to be the watchword of the next decade. Safety is economy. The railway which does not adapt itself to the new idea will run the risk of having its property condemned and turned over to public ownership and operation. The country is not ripe for this step, but the public is sometimes impatient. Such impatience can be controlled by good service by the companies and in no other way.

Illumination

Semi-Indirect Lighting

In the production of good illumination, whether in the home, factory, office, or other public buildings, it is generally recognized that very much depends on the location of the units and the kind, number and capacity of the light sources. Equally important however is the selection of proper glass ware, for herein consists largely the control of the light—whether it shall be patchy or evenly distributed; glaring or restful; irritating or harmonious; inadequate or ample for the specific requirements.

Such phenomenal progress has been made in the economical production of light during the immediate past that this phase of illumination has tended to overshadow the equally important question of distribution. It is plain however that with the developments in the one the necessity for the other becomes still more urgent, as, without proper control, the more brilliant light sources, are, excepting in rare cases, of little advantage.

The method of control of light generally divides itself into three classes: 1st, direct; 2nd, indirect; 3rd, semi-indirect.

The actual definition of or dividing line between these three classes has been the cause of a considerable amount of

Fig. 1—Toronto Public Library.

argument and discussion, but it now appears as though the following definitions were being recognized as standards. They have been recommended by the Research Committee of The Illuminating Engineering Society of the United States, who have made a careful study of the matter, and will probably be adopted in the near future by that society:—

Direct unit: A lighting device from which more than half the emitted light is directed downward or to the side, reaching the surface to be illuminated without being reflected to the walls or ceiling.

Semi-direct unit: A lighting device employing a diffusing or translucent medium which directs more than half of the light to the walls or ceiling to be re-directed for use, the remainder of the light being diffused through the medium.

Indirect unit: A lighting device from which all the light emitted is projected to the ceiling or walls and from there reflected to the object to be lighted.

Whether direct, indirect or semi-indirect illumination is best in any particular case can not be determined without

Fig. 2 – Private residence lighting.

careful study of the conditions surrounding the installation and the requirements of it. It is very important that no prejudice should be allowed to enter into this decision as undoubtedly each system has its place and is most suitable under certain conditions.

In our recent issues we have described a number of installations of direct and indirect illumination. We are

Fig. 3 – Dining room, Montreal.

illustrating in the present instance a number of interior illuminations by semi-indirect units and we are also showing three or four typical productions of the type of handsome glassware which is now being sold throughout Canada by a number of firms. For the particular cuts shown we are in-

debted to the Toronto office of the MacBeth-Evans Company.

Figure 1 is a view of a corner of the Toronto Public Library lighted by semi-indirect units. Alba glass is used and the effect is pleasing and restful, while at the same time ample illumination is provided for readers.

Figure 2 represents an installation in a private library of a prominent citizen of one of our Ontario towns. For reading purposes this unit was found to give a highly satisfactory distribution with a minimum of strain on the reader's eyes; also, the general effect is restful and soothing.

Figure 3 represents a semi-indirect installation in a private dining room in the city of Montreal. It is of Decora glass, Adam style and is one of the handsomest as well as one of the most satisfactory semi-indirect units that has yet been produced.

Figure 4 represents a standard semi-indirect unit, Ionic design. In many of these fixtures the upper single chain is discarded. The three suspensions running right up to the ceiling. This type of fixture is especially popular where the unit is only suspended a short distance from the ceiling.

Figure 5 is a unit specially designed for the new nitrogen lamp and is adapted for public buildings of all sorts.

Figure 6 represents an ornamental enclosing globe suitable for auditorium or other buildings where the decorative features are prominent.

Figure 7 is also a highly decorative unit suitable for corridors or similar rooms where the decorative features are given unusual prominence.

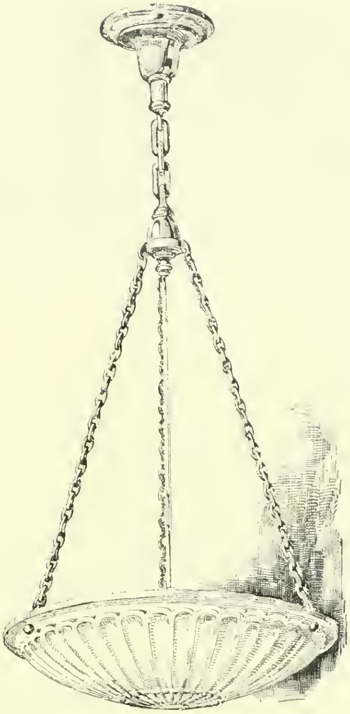


Fig. 4

Fig. 5

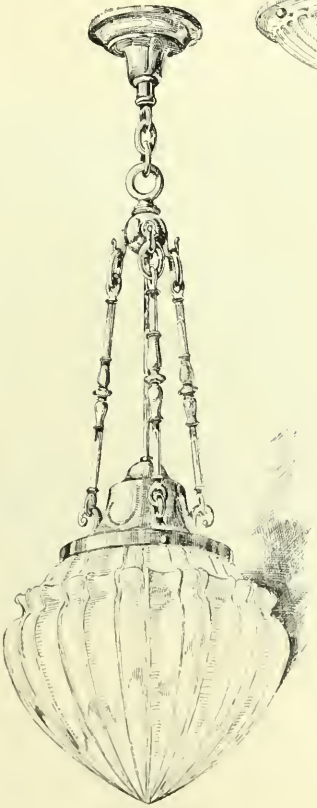


Fig. 6

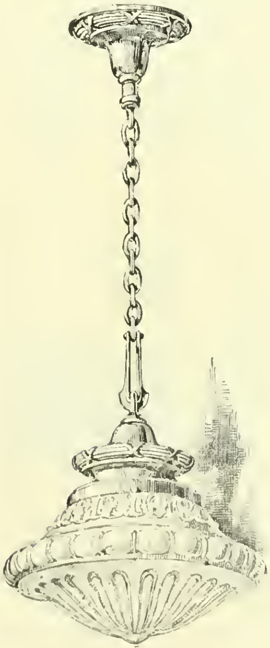


Fig. 7

The Dealer and Contractor

Standardization in Electrical Contracting

One of the most important pieces of work before the Electrical Contractor of the present day appears to be an agitation towards the standardization both of electrical equipment and its method of installation. Why, for instance, has the common outlet box not been standardized, both as to size and construction so as to accommodate all makes of switches. This has been accomplished to a certain extent it is true, and the manufacturers who hold out against standardization may feel that they stand to gain by maintaining a standard of their own, since when replacements and renewals are required, other makes of equipment cannot be used. On the other hand there can be no doubt that both the electrical contractors and the consumers are often greatly inconvenienced by the lack of standardization, and we believe every effort should be made towards a reasonable degree of standardization of equipment.

Standardization of construction methods are even more necessary from the consumer's point of view. At the present time it is either necessary for a householder, for instance, to be personally acquainted with his electrical contractor or to employ a firm with a very wide reputation. The employment of an electrical contractor which one may get in touch with through his advertising or the sign on his door, is to court imperfect, and probably unsafe, methods of installation. It is true the system of inspection generally employed tends to keep the work up to a certain standard, but an electrical installation is of that peculiar type which makes it possible for unscrupulous contractors to defeat the ends of municipal or other inspection, without much fear of detection. The standardization of installation methods may not remove the evil, but it would go some distance towards it.

In a recent issue of the National Electrical Contractor a plea for standardization is made by Mr. C. F. Butte, and in an interesting article which we reproduce in abstract, Mr. Butte considers that conditions would be ideal if all competitors figured all work on the same basis, and installed accordingly. Right here there seems to be a big work for the electrical contractor, which can only be accomplished by co-operation.

In certain local centres much has already been accomplished, but the need of a larger and more representative organization seems very necessary.

"It will not be the endeavor of the writer to dwell on this subject in any lengthy detail as to the courses to pursue, or to the methods to be adopted, owing to the limited space, but merely to write in a suggestive manner giving food for thought and depend upon the reader to apply, or develop any of the ideas that may be brought out.

Standardization is the keynote of all large industries in the present period, with the one aim in view: increase product, decrease cost and raise the quality and standard of the various articles that are made.

Scientific shop management is now on a well recognized basis, and the scientific engineer who continuously strives to standardize and reduce efforts is always in demand.

Why should not the electrical contractor standardize his work?

Why does one contractor install his work in one way and another contractor some other way, when the same construction should be used in both cases? Unquestionably, many of you have seen typical cases of this kind and wherein considerable cost and expense could have been saved the contractor and a better grade of work would have resulted had some previous standard been adopted for such work.

Standardization of panel boards, main switchboards of certain classes, meter panels, construction details, material forms, estimating methods and the many various details of the contractor's work, would unquestionably aid the contractor, minimize his efforts and work, thereby increasing his capacity, reduce the possibility of errors, educate and make his workmen more efficient, increase his profits by reducing any uncertain factors. It may be said that standardization would destroy individuality, but is it not an admitted fact that individuality is sometimes rather expensive, both to the individual contractor and to the contractors as a whole, competing for the same work due to incorrect figuring, inefficient and poor methods? Would not the ideal conditions exist if all competitors were on the same basis and figured on the work similarly?

As stated previously, it is not the intention to dwell in detail as to how or wherefore, but the writer would suggest that each of the various local contractors' associations take up the work of standardization in their localities, possibly starting with forms and blanks and gradually adopt standards for all the various details of construction.

Some readers may be somewhat skeptical as to the possibilities along these lines. In order to offset any argument along the skeptic's lines, let us dwell on what has been done by others. Not many years ago a machinist had considerable trouble with machine screws, machine bolts, drills and tools on account of the many various gauges, threads and sizes. Does he have the same difficulty at the present time? No, as the manufacturers have standardized.

Does the plumber have to buy Smith's or Brown's fittings to install his work? No, as the fittings are standardized. Many more similar cases can be cited wherein chaotic conditions have been corrected by standardization, but space will not permit."

The operation returns of the municipal street railway system, Regina, for the week ending July 11th are as follows:—Revenue, \$4,002.60; passengers carried, 94,825; passengers carried including transfers, 107,505.

The eighth annual convention of the Illuminating Engineering Society will be held in Cleveland, September 21-25 inclusive at the Hollenden Hotel. The Hollenden is an ideal location for convention purposes, having something like 40,000 sq. ft. of ground floor space and accommodation for 800 guests.

Low Voltage Lighting Plants

The need of electric light, in isolated localities not reached by Central Station lines, has long been felt, and has been one of the deterring influences in the re-trend of population from city to country. The safety, cleanliness and convenience of electric light is so generally recognized also, that there is every incentive to make it universally available. Abundance of light can no longer be classed as a luxury, but must be considered as a necessity to home comfort, within the reach of every moderate income.

With these facts in view, the Northern Electric Company has recently placed on the market, a low voltage lighting outfit, consisting of a storage battery, generator, gasoline engine and switchboard, for operation at 32 volts. The company recommend that for the successful continuous operation of a lighting outfit, of small capacity, it is better to have a storage battery that will take the bulk of the lighting, instead of relying upon the generator entirely for the electrical energy necessary. By so doing, the user obtains an absolutely steady voltage at the lamps and does not have to purchase a special electric engine for close speed regulation, which is comparatively exepnsive. They do not advise the purchase of a rubber jar battery for this service since the cell is entirely enclosed and does not offer a means of easy inspection of the plates and condition of the electrolyte, as is obtained with a glass jar battery. This is claimed to be an important feature, liable to be overlooked by the buyer who does not discriminate and who is too easily attracted by the slightly lower first cost of a battery in rubber.

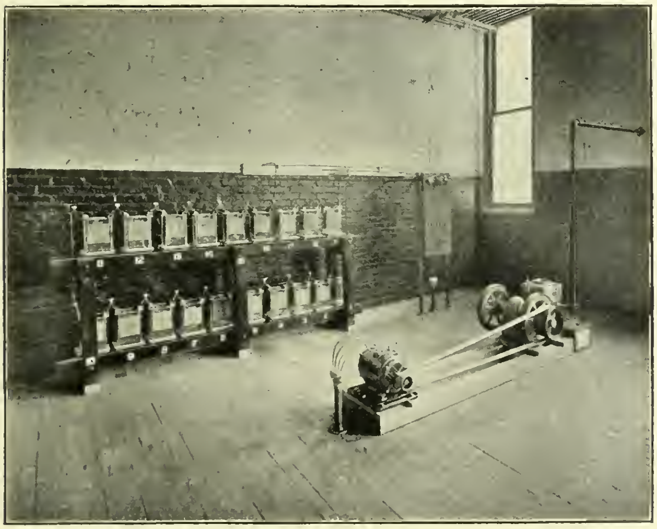
In accordance with these facts, all this company's outfits have been designed to incorporate a storage battery in glass, of sufficient capacity to furnish all the electrical energy required; the generator being used only for charging purposes. However, should the user desire, he may operate the battery and generator in parallel to obtain the combined capacity of both, which is accomplished by merely throwing a switch on the board; or, he may charge the battery while using current for lights or other purposes. Counter e.m.f. cells are provided to keep the line voltage normal in the latter case, since the charging voltage is always higher than normal voltage obtained from the battery.

A feature of the outfit is that when starting up the set, the generator may be run as a motor, using battery energy to turn over the gasoline engine. It is therefore unnecessary to turn the engine by hand, as is generally the case, when using the commercial types of small gasoline engines.

The switchboard is equipped with an underload circuit breaker, which shuts down the engine automatically when the battery becomes fully charged. This is accomplished by having the ignition circuit of the engine excited by the counter e.m.f. cells of the battery.

Besides using the outfit for lighting service, any household electrical device wound for 32 volts, may be conveniently used if the capacity of the battery is selected with that end in view. The owner of such an outfit can therefore enjoy the conveniences of the electric fan, iron, coffee percolator, toaster, vacuum cleaner, washing machine, etc., available for instant use at any time.

The low voltage lighting outfits are furnished with a special make of gasoline engine, which is characterized by its economy in fuel consumption, so that the cost of operation will figure down to approximately one cent to burn a 20 watt, 16 c.p. tungsten lamp for five hours.



A complete lighting plant for out-of-town requirements.

Attachment Plugs and Receptacles

The three-wire attachment plugs and receptacles illustrated herewith are being manufactured by Harvey Hubbell, Inc., Bridgeport, Conn. In Fig. 1 is shown a separable attachment plug which is rated at 660 watts for 250-volt circuits. The cap for this plug is made entirely of porcelain or of porcelain with a brass cover. The wall receptacle shown in Fig. 2 and the flush receptacle in Fig. 3 are rated at 10 amp. for 250-volt circuits. These plugs and receptacles are of the polarized type, making it impossible therefore, to reverse the polarity. They may be used with electric stoves, portable motors, etc.

Fig. 1

Fig. 2

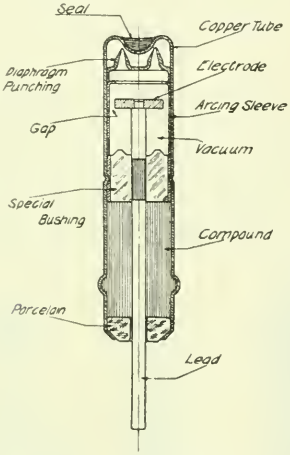
Fig. 3

The Ricetown Rural Telephone Company has awarded contract for an installation to cost some $13,000.

Vacuum Tube Lightning Arrester

A new arrester specially designed for railway signal circuits is being placed on the market by the Canadian General Electric Company. The two vital requirements in a lightning arrester for this particular service consist, 1st, in a low spark potential, and 2nd, in freedom from short circuits following lightning discharge. The first of these requirements demands a small spark gap; the second a larger one. By surrounding the larger gap with a vacuum, both requirements are met. In other words, the larger gap prevents short circuit, while the vacuum reduces the spark potential to a value much below what it would be in air and sufficiently low to afford protection. The new arrester is constructed of a metal tube with metal electrodes; this construction being finally chosen, after much experimenting, because, considering all requirements, it affords the best protection.

The arrester is essentially a gap in a vacuum. For the general internal construction see the accompanying illustration. The gap is formed between the inner wall of a drawn metal shell and a disk electrode mounted concentric with it. The electrode is supported on a brass rod 3-32 in. diameter,



Showing internal construction of arrester.

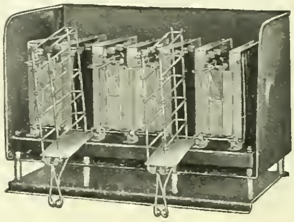
which serves as the lead-in connection, and has ample current-carrying capacity. The electrode system is insulated from the tube and rigidly supported in position by a bushing made of a special, accurately-molded, vitreous material which is unusually strong and able to withstand sudden changes of temperature. The bushing does not form the vacuum seal, however, that being made by a compound specially developed for the work. The open end of the tube is finally closed by a porcelain bushing held in place by spinning.

The tube is exhausted in a special machine which solders a small hole in the end after the vacuum has been established. The possibility of solder entering the active part of the vacuum space is prevented by a diaphragm punching, and both the electrode and the lining of the tube are of non-arcing metal.

The arrester has a spark potential of from 350 to 600 volts direct current, and an equivalent-needle-gap of about 0.005 in. It will discharge the heaviest strokes of lightning without damage to itself, the necessity for maintenance, or the possibility of short circuit. This was proven by tests at currents as high as 1,000 amperes, using a circuit breaker, and also from the repeated blowing of 35 ampere fuses on a 500 volt trolley circuit. It will not stand a continuous flow of current due to excessive heating. If there be a possibility of this due to high potential crosses, fuses must be provided.

Electric Toasting in Large Buildings

Toasting in hotels and restaurants makes a heavy, but intermittent demand on the kitchen equipment. Guests usually want their toast in a hurry and it must be served hot and fresh. Toasting a slice of bread properly is a short operation, but requires high temperature. The toaster illustrated herewith is capable of toasting six slices at once and



Large electric toaster.

is one of the most satisfactory devices available for the purpose. The coils grow red the instant the current is turned on and the switches are so arranged that two, three or six slices can be toasted economically and simultaneously in one minute. As will be noticed, the slices to be toasted are placed in hinged wire racks which are then tipped back into the toasting position between the heating elements. These elements, of which there are seven, are each composed of four vertical coils mounted on strips of mica. The coils are of Calorite wire noted for its durability. The sheet metal sides and back of the toaster act as a shield, preventing draught of air which might cool the coils Two controlling switches of the "on" and "off" indicating type are furnished and are intended to be mounted on the wall at a point convenient to the toaster. One switch controls three heating units, and the other four units. The toaster illustrated is being placed on the market by the Canadian General Electric Company.

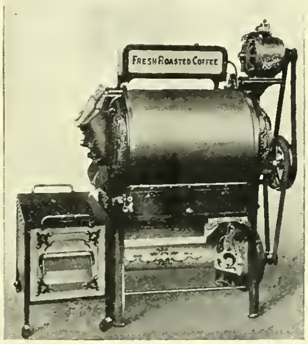
A Ten-Mile Cable

The telephone cable recently laid by the Dominion government connecting Halifax, N.S., with Charlottetown, P.E.I., was constructed in the cable works of the Siemens Company in England and was shipped to Halifax in one continuous length of ten nautical miles. The cable consists of four gutta percha insulated conductors, two of which will be used to make one telephone circuit; the remaining conductors will form two independent telegraph circuits. These four conductors are "cabled" together with prepared jute yarn and further covered with the same material to form a bedding for the armouring which consists of a sufficient number of galvanized soft iron wires of such a size as to give ample mechanical protection to the cable, having in view the local conditions of the neighborhood in which the cable is laid. The armouring is further protected by layers of tarred jute yarn and compound. This submarine cable is of the "loaded" type, the load coils being inserted at regular intervals; by this device from 2½ to 6 times the efficiency of the ordinary submarine cable is obtained.

On July 9 the strike which was declared some time ago among the employees of the Westinghouse Company at East Pittsburgh was called off by the men. Although the day set for returning to work was Monday, July 13th, a large number of the men reported on the Friday and Saturday preceding. The works have been running since July 14th at full capacity.

A Coffee and Peanut Roaster for the Retail Trade

Every one handling coffee knows that freshly roasted coffee is much better than that which has been roasted for some time, and those retail dealers desirous of serving their customers with the best have always been anxious to secure some means of roasting their own coffee. Heretofore, however, coffee roasting machinery has been so bulky and expensive that only wholesalers and others handling coffee in large quantities were able to install it. The Royal coffee



Coffee roaster.

roaster, made by the A. J. Deer Company, Hornell, N.Y., was developed to permit retailers to secure the advertising possibilities arising from supplying their trade with fresh roasted coffee. This machine is small, compact, and so simple in operation that any clerk can use it. The coffee is placed in a cylinder which is surrounded by a jacket and revolved by a Westinghouse Electric motor. Here it is subjected to the heat of a gas or gasoline flame, and when roasted, is dropped into a movable car where it is quickly cooled by means of an air blast. The style illustrated has a capacity of 25 pounds of coffee; its overall dimensions are: height, 4 feet 8 inches; length, 4 feet 8 inches, and width, 3 feet 4 inches. It will roast 100 pounds of coffee at a cost of 18 cents. This covers cost of the current for the Westinghouse small motor and for the gas for the flame. The Royal roaster is also suitable for roasting peanuts.

Sturtevant Vacuum Cleaners to be Sold in Canada

The B. F. Sturtevant Company of Canada, Limited, Galt, Ontario, intend marketing their vacuum cleaners in this country. These cleaners are sold very extensively in the United States under the name of the Western-Electric-Sturtevant vacuum cleaner. The B. F. Sturtevant Company are planning a vigorous campaign and are looking for agents in all the towns and cities where electric power is available.

New Companies

The Huntsville & Lake of Bays Telephone Company has been incorporated with $4,000 capital.

The Canadian Storage Battery Company has been incorporated with head office Toronto; capital $40,000.

The International Light and Manufacturing Company of Canada, Limited, has been incorporated with capital $150,000; head office Regina, Sask.

The City & Suburban Motorbus Company, Limited, of Toronto, has been incorporated with $250,000 capital. The name of J. R. L. Starr, barrister, appears as the incorporator.

46,000 Volt Cable

The Siemens Company of Canada have recently supplied a quantity of 46,000 volt cable to the Union Carbide Company, Niagara Falls, Ont. This cable is of peculiar construction having been designed to overcome the electric stress which would be greater than the dielectric stress of the innermost layer of the insulating material if the conductor were of the ordinary construction, the diameter of the latter being smaller than is allowed by theory. In order to obtain the necessary safe diameter for this cable the conductor has been formed by arranging the correct number and size of copper wires, to give the required cross-section of cable, around a centre of prepared jute yarn, and covering with a thin tube of lead as a further protection and to give the conductor a perfectly smooth appearance.

Trade Publications

Motor Car Accessories—Folder issued by the Canadian General Electric Company describing Adams-Bagnall electrical accessories for motor cars.

Carbureters—Booklet issued by the Canadian General Electric Company describing and illustrating carbureters, flexible tubing, motor specialties, etc.

Knife Switches—Bulletin No. 41 issued by the Canadian Krantz Electric & Manufacturing Company illustrating and describing their commercial grade knife switches.

Governors—Bulletin No. 44590, issued by the Railway Department of the Canadian General Electric Company, Limited, describing and illustrating type ML governors for motor-driven air compressors.

Graphic Instruments—Catalogue No. 321 issued by the Esterline Company, Indianapolis, illustrating and describing the Esterline curve drawing instruments. The catalogue contains very complete information on the construction, rating, consumption, etc., of these instruments.

High Voltage d.c. Equipment—Bulletin No. 44010 issued by the Railway Department of the Canadian General Electric Company, describing and illustrating the high voltage direct current equipment of the Pittsburgh and Butler Street Railway, which has now been operating for several months.

Westinghouse—Current publications include No. 8 of the Westinghouse Railway Data Exchange which contains information on "Efficient use of Cars" and "Cost of Stops"; a little booklet entitled "Drawing the Crowd and Keeping It"; and publication No. 1531 describing the wicker type electric linotype pots.

(Concluded from page 50.)

This hardware follows closely that already described for lower voltages.

The grounding straps shown on plate 34 are to be sheared, punched, formed and rivetted before galvanizing, in order that all exposed edges may be protected. They are held close to the cross-arm by driving in ordinary 1-inch galvanized roofing nails, holes being provided for this purpose.

In submitting this report for your consideration your committee have endeavored to eliminate the many types of "freak" construction and to suggest a good substantial line of fittings which can be utilized to economical advantage on construction where long life, permanency and reliability are of more importance than keeping the actual first cost at an absolute minimum. We believe that the types illustrated will result in an annual upkeep and overhead cost far below that obtainable by any construction where first cost is given sole consideration.

We trust we may have your approval of this work and that many, if not all, of the fittings shown may become standard with member companies in the near future; and until such time as the development of the art brings out ones of proven better design or utility.

Current News and Notes

Bolton, Ont.

A by-law will be submitted on August 3rd authorizing the council to enter into a contract with the Hydro-Electric Power Commission of Ontario for the supply of electric energy.

Brantford, Ont.

The Bell Telephone Company of Canada have commenced operations on an extension to their telephone exchange on Dalhousie Street.

Calgary, Alta.

It is stated that since the oil boom started some two months ago, more than six hundred new telephones have been installed in Calgary.

Cupar, Sask.

Tenders are called to August 7th for furnishing material and constructing a telephone system for the Dalrymple Rural Telephone Company. Plans and specifications may be seen at the office of the Provincial Department of Telephones, Regina.

Duncan, B.C.

The contract for supplying and installing the entire equipment required in the new city electric lighting plant was recently awarded to the W. Poole Dryer Company, Limited, electrical engineers of Vancouver, B.C., and Glasgow, Scotland. This installation will represent one of the latest developments in engineering practice in electric lighting plants as the dynamos are to be driven by Diesel engines burning crude oil of cheap quality. The equipment of the power station will consist of two Diesel engines each of 100 h.p. with 60 kilowatt alternating current generators and the necessary exciters mounted directly on the shaft of each generator. The contracting firm are having the Diesel engines, the Morley-Guldner type, made in Bradford, England, and are purchasing the electrical machinery, including the switchboard, from the Canadian Westinghouse Company. An interesting feature of the Duncan plant will be the unusually low cost at which it is claimed power can be generated, these engines consuming rather less than ½ lb. per B.h.p. of crude oil per hour. It is expected that the plant will be put into operation early in the Fall.

Edmonton, Alta.

According to a local press report, an offer has been made to the city council of Edmonton by a firm of New York engineers to sell electric energy in Edmonton at a rate of 1 cent per kw.h. if the city will guarantee a consumption of 50,000,000 kw.h. per year. It is understood to be the intention of this firm to develop a water fall on the Moose River, a tributary of the Fraser beyond the Yellow Head Pass, and transmit at high pressure some 250 miles. When the minimum consumption mentioned above is exceeded a graded scale is offered which becomes ½c per kw.h. When the yearly consumption reaches 100,000,000 kw.h

Estevan, Sask.

A contract has been awarded by the provincial government, Department of Telephones, for an exchange building to cost $20,000.

Hedley, B.C.

The Daly Reduction Company, of which the Hedley Gold Mining Company is a subsidiary concern, recently purchased from the Canadian Westinghouse Company a 1,250 kv.a., 3-phase, 60-cycle, 400 r.p.m., 6,600 volt, waterwheel driven generator complete with direct connected exciter, switchboard and electrolytic lightning arresters for both the mining company's generating station and the receiving end of the transmission line. The Morgan Smith Company got the order for an 1,800 h.p. waterwheel. A 440 h.p. synchronous motor which will be direct-connected to a compressor purchased from the Canadian Ingersoll-Rand Company, has been obtained from the Canadian General Electric Company who also supplied a 400 h.p. induction motor to drive a compressor which at present is driven by steam, as well as three 400 kw. self-cooled transformers. Greater power facilities for the mining operations of the Daly Reduction Company have been rendered imperative on account of the company's steadily increasing gold output, and the present steam and small hydro-electric plant will be supplemented by the installation of the recently acquired equipment at a point on the Similkameen River, necessitating the construction of a three-mile transmission line between the new hydro-electric development and the mill. January 1, 1915, has been named as the probable date for putting the new plant into commission. Mr. Gilbert McEachern is electrical superintendent of the Daly Reduction Company, and Mr. G. P. Jones, general manager.

Kingston, Ont.

The local electric railway company which formerly ran their cars on Sunday have discontinued the service during the last two or three years. There is now an agitation among the citizens to have this service renewed.

Lacombe, Alta.

The Waterous Engine Company, Brantford, have been awarded a contract for a boiler to be installed in the electric light plant.

Lumsden, Sask.

The town of Lumsden has closed a contract with the Ferranti Electrical Company for a small alternator.

Moosimin, Sask.

The Saskatchewan Government has awarded a contract to The Ferranti Electrical Company for two generators, and switchboard, for the government jail at this point.

Montreal, Que.

It is announced that the power plant which was to have been erected on the Lachine Canal by the province of Quebec will not be proceeded with at present. Some preliminary development work has been undertaken.

The Canadian Westinghouse Company have secured an order from the Bathurst Lumber Company, Limited, Bathurst, N.B., for two 1,500 kw. turbo-generator sets, complete with jet condensers. Babcock and Wilcox boilers, with Foster super-heaters, will be installed. The equipment is required for a pulp mill which is being constructed.

Under an amended by-law, the Montreal Electrical Commission is given power to compel the removal of wires, overhead cables, poles, and transmission lines (with the exception of trolley wires) on the completion of the underground conduits or portion thereof. The Commission will also fix the rentals to be paid annually to the city for the use of the conduits.

The question of a new franchise for the Montreal Tramways Company has been again discussed. The civic Controllers have referred the subject to one of their num-

ber for a report on the franchise and the provision of additional facilities. The Controllers are by no means agreed on plans to be adopted. Mr. Duncan Macdonald favors the preparation of a plan for subways and motor busses, while Mr. Herbert is against motor busses and advocates subways to be used in conjunction with the surface cars.

The Bell Telephone Company have either let contracts, or will shortly do so, for the following extensions: two-storey branch office, Bloor and Dufferin Streets, Toronto; two-storey building, North Toronto; extension of present office on Dalhousie Street, Brantford; three-storey building, Apple Street, Brockville; three-storey building, Cork Street, Guelph; branch office, Garfield Avenue, Hamilton; three-storey, King Street, St. Catharines; three-storey building, Sherbrooke.

Only two tenders were received by the Controllers of Montreal for the construction of underground conduits on St. James, Notre Dame and Craig Streets, and the intersecting streets between Craig and Notre Dame Streets from McGill Street to St. Lawrence Boulevard. The contract was awarded to Mr. G. M. Gest, who has secured all the other conduit work for the city, plans for which were drawn by the Electrical Service Commission. The sum of $175,000 has been set aside for the latest contract, this including certain charges for engineering work.

The Eugene F. Phillips Electrical Works, Montreal, have obtained the following orders: 23 miles of cable for the city of Westmount, chiefly single and twin conductor of 7,500 volts, for use in connection with the new street lighting system of the city; 10 miles of 4400 volt three conductor cable for the Montreal Light, Heat and Power Company, to be used for conduit work; 10 miles of single conductor 4400 volt steel tape armored cable for the Hydro-Electric Power Commission of Ontario. Mr. Lawford Grant, manager of the Company, is on a trip to the Pacific Coast with a view to studying the business conditions. He will be away for about three weeks.

Cutlook, Sask.

Tenders have been called by the Garden Valley Rural Telephone Company for the supply of material and construction of their telephone system.

Saskatoon, Sask.

A contract has been awarded by the city of Saskatoon covering one 600 kw. Peebles' La Cour motor-converter with auxiliary switch gear. This machine will operate in traction service in parallel with existing motor-generator sets. The motor-converter is comparatively new in Canada and was selected in this case as being superior to rotary converter or motor-generators for the particular service required.

St. John, N.B.

The St. John Railway Company, through their solicitors, announce that they will extend their line of street railway through Glen Falls sub-division as far as Maynor House and that the work will be proceeded with immediately.

St. Thomas, Ont.

The City Council have decided to remove the arc lights at present used on Talbot Street and install nitrogen tungsten lamps. The cause of the change is partly on account of the decayed condition of the poles which at present support the wires and lamps. It is understood that these will be replaced by metal combination trolley and lighting poles from which the tungsten units will be suspended some sixteen feet from the ground. The arcs to be removed from this street will be concentrated in another section of the city where direct-current is available. In this way a much improved lighting service will be given throughout the city generally.

Toronto, Ont.

Plans have been approved by the Board of Control for a new car barn in connection with the Danforth Avenue section of the Toronto municipal electric railway system.

At a meeting of interested municipalities held recently, it was decided to inaugurate a vigorous educational campaign regarding hydro-radials throughout the Markham, Stouffville, Whitby, Port Perry and Uxbridge district. A schedule of lectures will be drawn up and every effort will be made to interest the electors and to give them all possible information preparatory to submitting by-laws in the near future.

Negotiations are proceeding between the Toronto & York Radial Company and the city of Toronto regarding the running of the Sunnyside cars over the new G. T. R. bridge. This would bring the suburban electric cars close to the point where the Toronto Railway system discharges its passengers at the western terminus of King and Queen Street lines, and would be a great convenience for passengers living in the western suburbs.

Vancouver, B.C.

The Canadian General Electric Company is delivering to Barr & Anderson, two 300 kv.a. 125/250 volt, three-wire generators which will be driven by Goldie & McCulloch cross-compound Corliss engines. This equipment will be installed in the new Vancouver store of the Hudson's Bay Company for which Barr & Anderson, Vancouver, have the contract for supplying the general mechanical equipment. It is expected that the plant will be operating about the middle of September.

That continuous advancement is being made in every part of the province is shown by the statement of development published monthly in Telephone Talk, the magazine issued by the B. C. Telephone Company. Thirty-nine telephone exchanges are operated and gains are recorded in nearly every instance, with very perceptible progress in the larger cities. Another article details extensions of outside plant which are in hand as well as additions to equipment in several of the offices. These are all on account of new business, indicating a live growth. One of the feature articles in Telephone Talk this month is descriptive of Grand Forks and district. This city is fortunately situated, having fine prairie-like farmlands in its immediate vicinity, and the illustrations show that it is up-to-date and progressive.

Victoria, B.C.

The new Royal Jubilee Hospital for which tenders were recently awarded covering the first unit of the construction, which comprises a brick power house and laundry buildings, will be equipped with an isolated electrical plant, designs of which have been prepared by Herbert C. Moss, of Seattle, Wash. As it is intended to proceed with only a section of the main building scheme at the present time, contracts will be taken for one 75 kw. and one 125 kw. turbo-generator set, provision being made for duplicating the two machines for future extensions. The plans and specifications of the electrical equipment include the installation of fixtures and lamps complete, designs of the fixtures being furnished. A special signal system will be installed to operate in conjunction with the clock system, and all calls will be recorded on a tape both at the time they are made and when answered. Electrically heated Gurneys are to be provided for conveying food from the kitchens to the different wards. The installation throughout will be thoroughly in keeping with the high standard of efficiency set by the architect, Mr. Loring P. Rixford, of Victoria. According to Mr. Moss, who has had considerable experience in designing the electrical equipment of large hospitals, the Royal Jubilee Hospital is the most convenient and best equipped building of its class he has ever worked upon. The total expenditure involved in the construction amounts to close on half a million dollars.

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Canadian Water Powers

In connection with the International Engineering Congress which is being held at San Francisco next September during the Panama-Pacific Exposition and under the auspices of the four National Engineering Associations of the United States, arrangements have been made by the Dominion Government to have the tremendous water power resources of Canada properly presented.

Preparations for a Water Power Exhibit in the Canadian Building at the Exposition have been under way for several months, and it is understood that this will take the form of a large landscape painting of Canada, about 70 ft. long by 9 ft. high, arranged in a semicircle, in front of which there will be working models of typical water power plants from the Atlantic to the Pacific. This painting will be the largest of the Dominion of Canada ever attempted, and is being executed by Mr. Gibson Catlett, landscape artist, of Toronto. The models themselves, some 14 in number, are being constructed by engineers in Toronto under the direct supervision of the Superintendent of the Dominion Water Power Branch, Mr. J. B. Challies. In addition to this water power exhibit, the Dominion Government has arranged to have papers prepared and read at the Congress by eminent Canadian engineers. These papers, and the discussion arising therefrom, will give the Congress some conception of the water power situation in Canada.

This Congress will offer an excellent opportunity for having Canada's immense water power resources, and the tremendous strides that have already been accomplished in development of these water powers, placed before the eminent engineers who will attend from all over the world. Every effort will be made to have as many of these engineers as possible return home to their own countries through Canada, in order that they may visit the well-known power developments throughout the country, and at the same time secure an accurate knowledge of the great industrial and commercial development, which is so dependent on cheap hydro-electric power. Enormous benefit has already been realized by this country from the visit of the foreign geologists to Canada last year. Probably no better investment has been made by the government than the financial grant for the entertainment and cross-country tour that these geologists made, under the direction of the Director of the Geological Survey of Canada . Hundreds of thousands of dollars of foreign capital has since been invested in this country in mining operations as a direct result of advice given foreign capitalists by these geologists, who were given every opportunity of seeing for themselves the great mineral wealth of the country awaiting capital for development. As cheap hydro-electric power is the keynote to the future industrial development of this country, every effort should be made by the government to have all water powers of economic importance thoroughly investigated by competent engineers, and developed wherever there is any reasonable demand for power.

We have been given to understand that the large railway corporations and the operating power companies throughout the country are co-operating with and tendering every possible assistance to the movement for having Canada's water power resources advertized in the best possible manner at the Panama-Pacific Exposition.

Our Electrical Exhibition

Manufacturers and dealers in electrical equipment will doubtless, as in the past, this year spend very considerable sums of money in displaying their products before the million, and more, people that will attend the Canadian National Exhibition. There is no doubt that this display is good business, as the people who attend the exhibition go there with a desire to see the advances that have been made during the past year. It follows that the impressions they get of any particular industry regulate, largely, their conversation and their purchases during the following twelve months.

The electrical display at Toronto's yearly exhibition has during later years been most excellent and of a highly attractive and educative nature. As we have said before, however, and as the average visitor is constantly saying, the scattered arrangement of the electrical exhibits makes it practically impossible to form either a comprehensive or a relative opinion on the various classes of equipment shown. A separate building to be known as the Electrical Building is as important as a separate building for art, or stoves, or manufacturing, or sheep, or hogs. Even more so, because the electrical idea is a comparatively new one. Its magnitude is not appreciated nor the practical value of the thousand and one devices which are now on the market. For this reason, again, it is all the more necessary to emphasize the importance of the electrical industry by having it all in one building so as to make as good a showing as possible.

There is probably no more aggravating experience, either, than that of the technical electrical visitor who attends the exhibition chiefly to see the electrical display. He trots about from one building to another in a vain effort to see all the exhibits; losing time and patience before he locates some of the most interesting equipment in some of the most obscure corners and in the most incomprehensible surroundings. The writer remembers, in the recent past, an electrical exhibit among the fancy work and still another among the vegetables. This may be good enough strategy from the point of view of that particular dealer but it is not so from

the point of view of the electrical industry as a whole. the magnitude and importance of which it should be the chief aim of the exhibitors to demonstrate.

Possibly, manufacturers and dealers do not sufficiently appreciate that this is the best opportunity of the whole year to show the purchasing public what they have to sell and why they should buy it. On the other hand, it is more than possible the exhibition management do not appreciate the value of our industry or the fact that they are losing many valuable exhibits through lack of proper accommodation. It is sincerely to be hoped that something may be done even yet this year to remedy one of the most apparent defects in our truly wonderful national annual display.

Conservation in Quebec

The Quebec Streams Commission have just issued, in two volumes, the English translation of their second report covering the work of the year ending November 30, 1913. The report covers much work looking to the general study of water power conditions and storage of water powers for industrial developments, but it also deals especially with the proposed water storage on the St. Maurice River. The Quebec government will erect a large storage dam some 240 miles from the mouth of the St. Maurice and at a point just above the La Loutre Falls. Plans of the dam are reproduced in the report which also include plans for a small water power development to be used to operate the control gates.

The necessity for storage on this river is shown by the great variation of readings taken at different points at different seasons of the year. For example at Shawinigan, a minimum of approximately 6,000 second feet has been observed as against the maximum of approximately 170,000 second feet, so that the proportion of flood to low water is almost 30 to 1. Higher up the river the variation is not so great, due to the fact that the large lakes act as natural reservoirs. The following figures give an estiamte of the different falls on the St. Maurice with data in connection with each, the capacity under the present conditions, the capacity under regulation conditions, etc. It is understood that the figures representing the present developed capacity of the plants do not include two 37,000 h.p. units since installed at Shawinigan and some 50,000 h.p. in turbine units being put in at Grand Mere by the Laurentide Pulp Company.

The Quebec Streams Commission is composed as follows:—S. N. Parent, chairman, Ernest Belanger, C.E., and W. I. Bishop, C.E.; H. L. DeMartigny is secretary; Olivier Lefebvre, C.E., chief engineer. A number of prominent engineers have been connected with the work including J. W. Thurso, C.E., Edward Wegmann, James M. McCarthy and Arthur St. Laurent.

Two Interesting Reports

Two valuable reports were presented by Mr. Magalhaes and Mr. Maclachlan respectively at the recent annual meeting of the Canadian Electrical Association. These reports are referred to in extract on other pages of this issue. Mr. Magalhaes' report dealt with the work of the Meter Committee of the N. E. L. A. Mr. Magalhaes pointed out the three general sub-divisions of the year's work and placed particular emphasis on the spirit of co-operation that existed between the regulation commissions and the N. E. L. A. association, as also between the manufacturers and the association. It was pointed out that this co-operation was a mutual benefit to all the parties concerned and should obtain to the same extent in Canada. Mr. Magalhaes also drew attention to the practical manner in which the several committees developed the reports they were required to present. A report differs from a paper in that it is the unanimous consensus of opinion of several men each of whom represents a commercial organization having daily experience of

STATEMENT OF THE WATER-POWERS ON THE ST. MAURICE RIVER

NAMES	Distance from St. Lawrence, (miles.)	Head in feet.	Approximate area of drainage basin above (sq. miles.)	Actual minimum flow, O.37 cu. ft. per sec. per sq. mile.	Present value 80% efficiency.	Regulated minimum flow of 12,000 c.f.s. at Shawinigan.	Value after regulation.	Increase in value through regulation	Power installed.	Increased primary power which will be used.	Increased power left unused.	Increased water-power yet unsold.	Present owner.
	Miles	Ft.	Sq. M.	c. f. sec	HP.	c. f. sec	HP.	HP.	HP.	HP.	HP.	HP.	
La Gabelle	13	10	16550	6123	5556	19123	11010	5454	......	......	5454	......	Grès Falls.
Les Grès	15.5	40	16500	6105	22200	12105	44018	21818	......	......	21818	......	" "
Shawinigan	21	150	16200	6000	81818	12000	163636	81818	183300	81818	......	......	Shawinigan W & P Co.
Grand'Mère	33	75	15860	5870	40022	11870	80931	40909	19500	40909	......	......	Laurentide Co.
La Tuque	103	80	12000	4440	32291	10440	75927	43636	3500	......	43636	......	Q. & St. Maurice Industrial Co.
Sans Nom	110	128	10030	3711	4318	9711	11300	6982	......	......	......	6982	Crown.
Vermillon	119	16	10020	3707	6066	9707	15884	9818	......	......	......	9818	"
Blanes	138	136	8115	3002	37115	9002	111296	74181	......	......	......	74181	"
Grands-Cœurs	171	90	6425	2377	19418	8377	68539	49091	......	......	......	49091	"
La Grâce	183	33	6325	2340	7020	8340	25020	18000	......	......	......	18000	"
De L'Ile	191	44	6225	2303	9212	8303	33212	24000	......	......	......	24000	"
									206300	122727	70908	182072	

the matters under discussion. Until each point has been definitely settled it is not allowed to appear in the report.

Mr. Maclachlan outlined the work of the street lighting committee of the N. E. L. A. and pointed out a number of advantages that were accruing to the Canadian Electrical Association from the affiliation. Mr. Maclachlan mentioned the quantity of data, for example, in connection with modern illumination, that had been collected by the N. E. L. A. and emphasized the value that such information must be to every Canadian company. The work of the street lighting committee for the past year is outlined in considerable detail.

The Aluminium Arrester

We print elsewhere in this issue a paper presented by Mr. E. E. F. Creighton before the A. I. E. E. on "The Present Status of Aluminum-cell Lightning Arresters," with the discussion which followed. The subject is treated in a general way and an effort made to answer the oft-repeated question as to whether aluminum lightning arresters are actually performing the service that is claimed for them, why they appear to be efficient in certain cases and not in others and whether they are likely to be superceded by other types. The answer given by Mr. Creighton and borne out by the speakers which followed demonstrates pretty clearly that the aluminum arrester is an exceedingly valuable equipment not likely to be superceded but, on the contrary, almost certain to come into general use, with the better understanding of the requirements of transmission lines and the corresponding changes and improvements in the arrester. The point brought out most forcibly in the paper is that we do not yet understand the nature of a lightning flash. Indeed, it is impossible to anticipate the effect of any lightning flash in as much as the characteristics of different flashes very widely. Much also depends upon the point at which the lightning strikes the line. These facts account for the apparent failures of aluminum arresters to protect the line under certain conditions. It is not, Mr. Creighton points out, that these arresters cannot be made to meet any particular conditions that may arise, but that, to date, they have not been able to be constructed so as to meet all the conditions. Dr. Steinmetz contributed some important information regarding the form of the wave front of a lightning surge and pointed out that the form of this wave when it reaches the arrester will vary very greatly with the distance it has travelled and the resistance it has met with.

Underground Work in Toronto

A quantity of underground work in connection with the municipal electric distribution system is at present under construction in Toronto. This consists of building a 15-duct run on the south side of King Street from John Street to Jarvis Street. Single 3-in. clay ducts are laid three wide and five high the top layer being square bore distributor duct. Several difficult channels have had to be made under car tracks, namely at York Street, Bay Street, Yonge Street, and Church Street. A single fibre duct of 3-in. diameter is used to connect run to all service boxes in the old run in the sidewalk. The ducts are encased in three inches of concrete and are laid with a minimum cover of 30 ins. from top of pavement.

In addition to the above work six large concrete transformer pits are being built. The dimensions of these pits are 9 ft. x 20 ft. x 12 ft. deep, inside measurement. The pits will have 13-in. concrete walls and will be provided with special ventilation chambers. These pits are of sufficient size to take care of additional load in future years.

The above work is being done by contract, the G. M. Gest Company, Montreal, being contractors.

A feature of the work is a special tamping machine operated by a little gasoline engine. This requires two men to operate but accomplishes the work of several and does it better.

Growth of Electric Vehicle Interests

The development which the year 1913-14 has witnessed in the electric vehicle field is phenomenal. Starting off last year in October the Electric Vehicle Association had but 437 members, with but two cities in which local organization had been organized. Since that time the membership has been increased to approximately 850—about 100 per cent—and the Sectional representation has expanded until it now includes New England, Chicago, Philadelphia, Washington, Cincinnati, San Francisco, Los Angeles, Pittsburgh, New York, Detroit, Cleveland and Toronto with expectations of having local sections in the immediate future in Buffalo, St. Louis and three or four other cities. In each of these local sections organized efforts are being put forth to promote the sale and use of electric vehicles, both passenger and commercial and it is safe to predict that these mediums will greatly facilitate electric vehicle development work in the year 1914-15.

Considerable progress has been made in the matter of the fifth annual convention of the Electric Vehicle Association, which this year will be held in Philadelphia, October 19, 20 and 21. All the convention committees have been organized and reports indicate interesting developments. To date the following tentative programme has been arranged.

Reports—Executive Secretary; Committee on Membership and Formation of Sections; Committee on Operating Records; Garage and Rates Committee; Insurance Committee; Papers Committee; Committee on Legislation; Committee on Educational Courses; Standardization Committee; Traffic Committee; Good Roads Committee; Central Station Co-operation Committee; Parcels Post Delivery Committee; Railroad Development Committee; Motion Picture Film Committee; Constitution and By-Laws Revision Committee; Report of the Secretaries of the Sections.

Papers—Progress of the Electric Vehicle; Unusual Application of Electric Trucks; The Motor Truck in Terminal Freight Handling; The Electric Vehicle in Parcel Post Service; National Electric Light Association's Electric Salesman's Handbook, with especial reference to Electric Vehicle Section; Electric Industrial Truck (Symposium); Educating the Public to the Field and Use of the Electric Vehicle; Electric Fire Apparatus.

Large African Plant

One of the largest electric generating organizations in the world is in Africa where the Victoria Falls, the Transvall Power Limited, and the Rand Mines Power Supply, Limited, under the same control, now have installed a maximum generating capacity of 182,000 kv.a. in 19 units and a capacity of 229,500 kv.a. in transformer units. The generaators vary in size from 4,000 up to 18,000 kv.a. There is also at the present time in course of erection, by this organization, at Brakpan, two 18,000 kv.a. sets together with 37,500 kv.a. in step-up transformers which it is expected will be ready for operation in January, 1915. This will bring the total generating capacity of the plants of this organization up to 218,000 kv.a., and the transformer capacity up to 267,000 kv.a. Two high tension transmission lines are in service, one 136 miles the other 88 miles in length. Transmission on the former is at 80,000 volts and on the latter 40,000 volts.

New Hydro-electric Plant of E. B. Eddy Co.

Three 4500 H.P., Four-Runner Turbines—High Efficiency Generators—Separate Motor Room and Pulp Mill—Latest Approved Construction Throughout

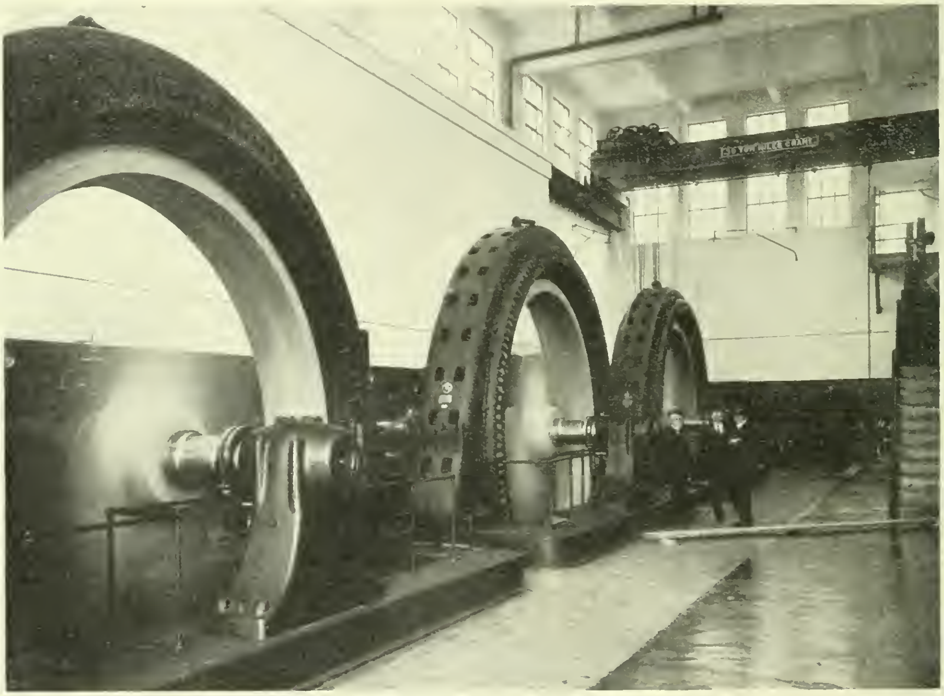
The E. B. Eddy Company have recently placed in operation a 11,250 kv.a. hydro-electric station in Hull which derives its power from the Ottawa River at the Chaudiere dam within the city limits of Ottawa and Hull. The plant as completed consists of a power house for generating and a separate motor and pulp house where the electric current is utilized.

The power house is of reinforced concrete construction and presents a very substantial and attractive appearance. It is conveniently located almost in the centre of the Eddy company's factory buildings. The forebay has been completely decked in with reinforced concrete arched work of sufficient strength to carry future factory extensions.

Into this forebay hot air from the paper machine room is exhausted by means of fans which is designed to maintain the temperature at such a point that anchor ice will not be formed.

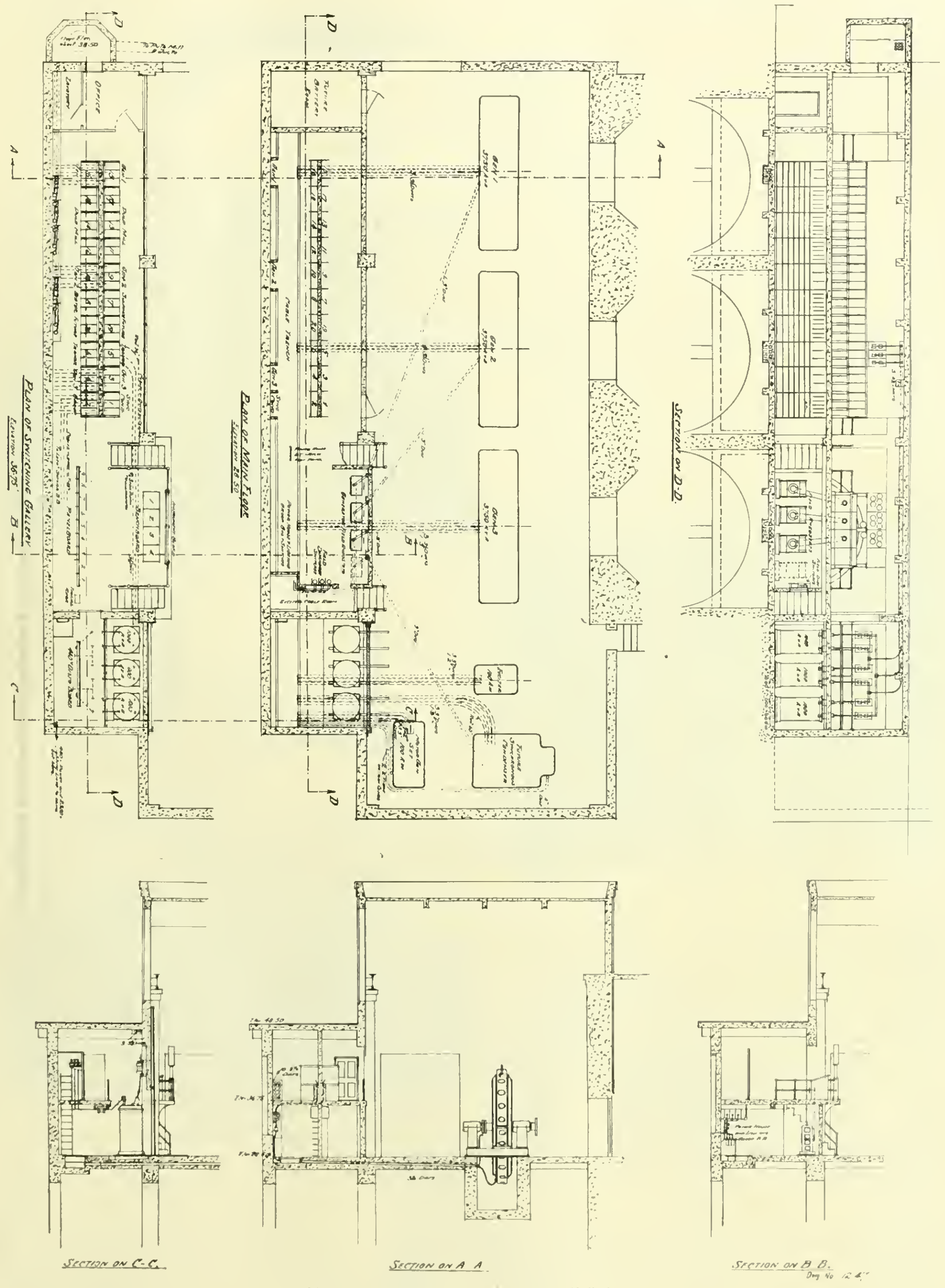
The head gates are operated by means of an electric crane which also runs over the wheel pit hatches.

The new plant comprises three units. The water wheels are of the horizontal open flume type, each unit having four runners operated at a normal head of 32 feet. At 164 r.p.m., each turbine is rated at 4500 h.p. The turbines are controlled by 60,000 foot pound horizontal type Lombard governors, said to be the largest of their kind manufactured by this company to date. One exciter turbine has also been installed. This unit has a capacity of 130 h.p. operating at 425 r.p.m. under a 30 foot head. The design of the turbines and the plan of installation are shown in two of the accompanying sketches. Two of the photographs reproduced also represent one of the units under construction. These units have been specially designed to suit the operating conditions of the Eddy company and particular attention has been paid to easy dismantling and assembling of the various parts in case of accident. All bearings are oil lubricated and accessible during operation by means of channels connecting each bearing pit with the generating room. The guide vanes are all cast steel. Each runner is pressed upon the forged hub which is one solid forging with the shaft and forms at the same time the coupling for connecting the next piece of shaft. The reproductions show sufficiently clearly the manner in which this work has been carried out. A feature of special mention is the construction of the runner, the buckets being of 3/8-in. steel plate and welded into cast iron rim and hub by means of a special welding process. It is impossible for any of these buckets to come loose and experience has shown that the steel plate will tear rather than break loose from the cast iron.

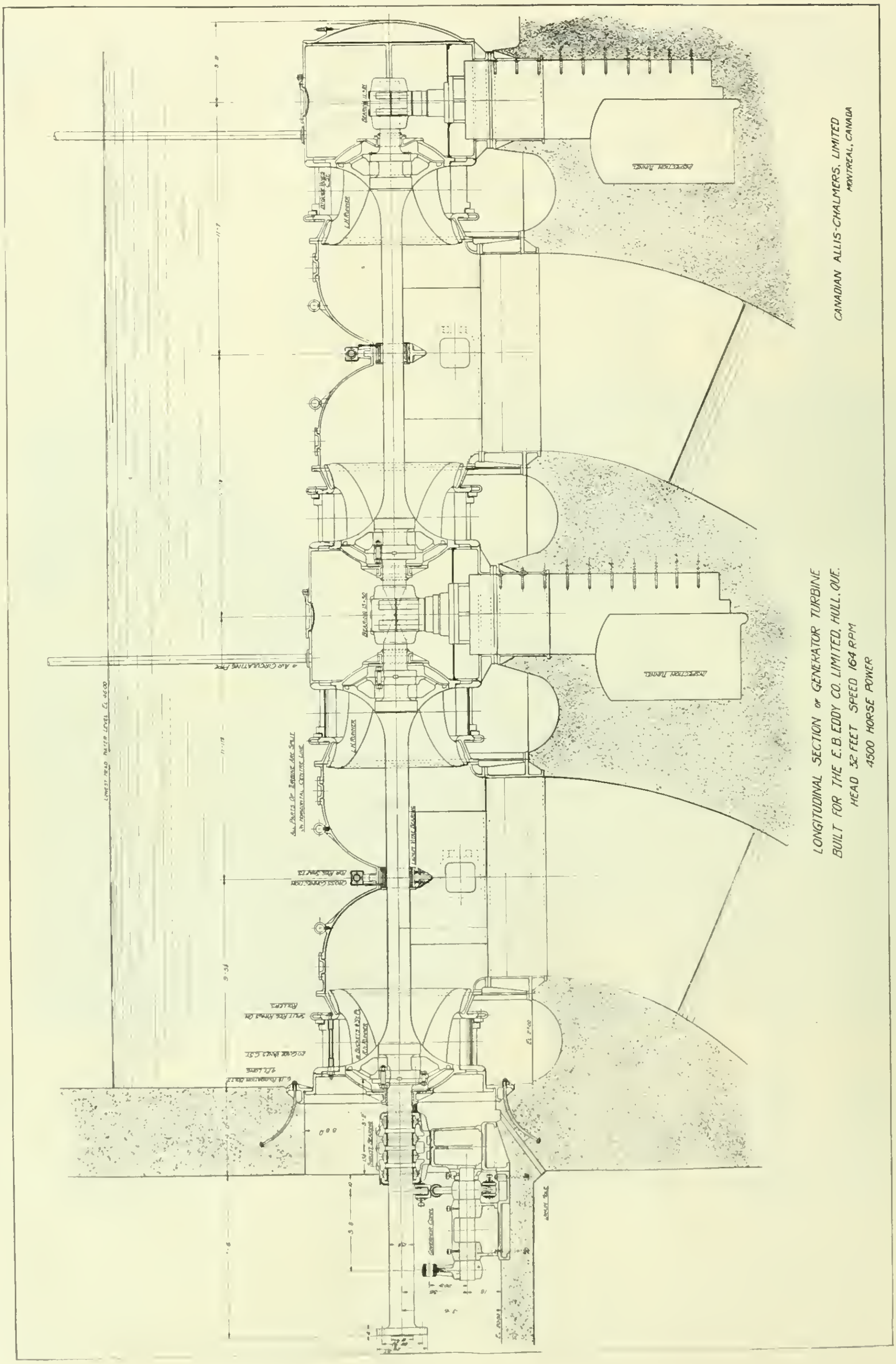


Generators, in operation, in the new E. B. Eddy Plant, Hull, Quebec.

As each unit is approximately 45 feet long special care had to be taken to prevent torsion in the gate shaft. The



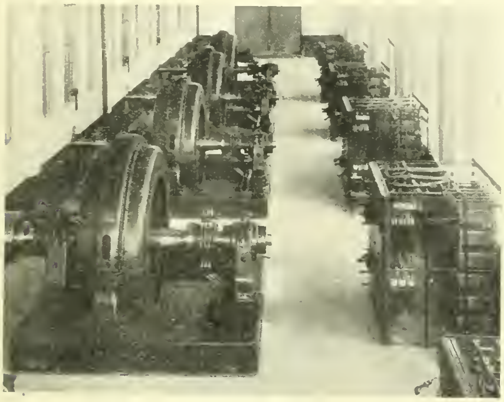
Plans and sections, new E. B. Eddy Plant, Hull, Que.



Section of one of the four-runner turbines. E. B. Eddy Company's plant, Hull, Que.

method used of connecting the gate shaft with the governor has proved superior to any other form of construction and careful measurements taken on the guide vane openings show that all vane openings are exactly the same in any position.

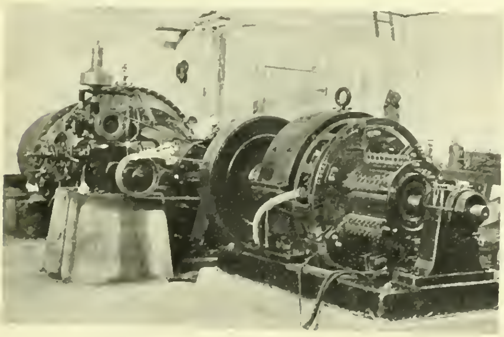
All hearings are furnished with stationary oil rings which carry the oil from the lower pit to the upper end, and a special wiper is arranged to wipe the oil off these rings and distribute it into the lubricating channels. These bearings at the same time have the advantage of acting as thrust



Motors are in a separate room from the grinders.

bearings and during operation have proved to be very satisfactory and to keep perfectly cool. The inside bearings placed in the draft chest are easily accessible and adjustable by means of bronze adjusting screws. They are of lignum vitae construction, lignum vitae strips being placed into separate cast iron shells.

During the test of these units it was demonstrated that they will develop 4800 h.p. at a little less than 31 ft. head and full speed of 164 r.p.m., and repeated inspections during the six months of operation have shown that all parts of the



Turbo-generator exciter, with fly wheel and governor.

machines are operating to the satisfaction of the purchaser.

The exciter turbine is of the end inlet type in cast iron casing. This is shown in one of the illustrations which also includes the regulator, regulating flywheel and generator.

As may be seen from the section drawing the turbines are of the open type being installed directly in the forebay. The exciter turbine, which is of the end open type, is set with its end in the wall which separates the forebay from the generating room.

The Generators

The three generators installed are of the horizontal water wheel type and each has a capacity of 3750 kv.a., 2300 volts, 60 cycle, 3 phase when operating at 164 r.p.m. The power generated is used for driving induction motors located in a separate building and connected to pulp grinders, as well as other small motors connected to various machinery used in the Eddy plant. The stator coils of the generators are insulated from the laminations with mica tubes and the rotors, which are banded with steel rings, are constructed to withstand a 100 per cent. overload in the event of a runaway.

The guaranteed efficiency of these generators was as follows: 1¼ load, 96 per cent.; full load, 96 per cent.; ¾ load, 95 per cent.; ½ load, 93 per cent. As against this the results of the tests carried out in the workshops of the manufacturers by a disinterested firm of consulting engineers is of interest. These gave efficiencies as follows: 1¼ load, 96.9 per cent.; full load, 96.6 per cent.; ¾ load, 96.1 per cent.; ½ load, 94.7 per cent. These results are tabulated below for comparative purposes:—

Efficiency	1¼	1/1	3/4	1/2
Result of test	96.9%	96.6%	96.1%	94.7
Guaranteed Efficiency.	96%	96%	95%	93

The regulation of these generators also proved to be better than the guarantee. At full load, 100% power factor,

Bus and switch structure all concrete.

the guarantee was 8%, while the test gave 7.4%. At full load and 80% power factor the test was 14.8% as against a guarantee of 20 per cent, so that in all the tests the machines exceeded the guarantees by good margins.

The exciter turbine consists of a 100 kw. compound wound, interpole unit direct connected to the water wheel and operating at 450 r.p.m. There is also installed a 100 kw. motor-generator set running at 580 r.p.m. with an electrically operated equalizer switch.

The switchboards are placed on a gallery built over the bus chamber, step-down transformers and the electrically operated oil switches. The bus chamber contains two sets of busbars on to which any of the machines or feeders can be sectionalized, or the two sets of busbars can be run in parallel if desired. The bus and switch structure is all of concrete.

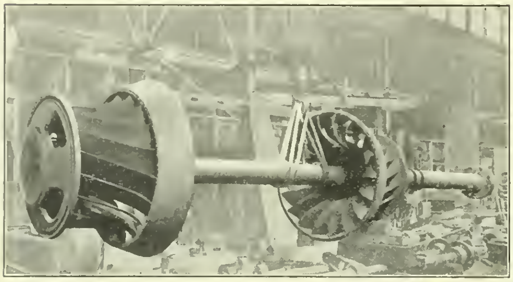
The generators are controlled from a bench board with electrically operated field switches and electric governor control. The instrument board for the machines is mounted on pedestals immediately behind the bench board. Each generator panel has three ammeters (one on each phase) a volt meter, power-factor meter and watt meter. There is also

a frequency meter and volt meter on each set of busbars. The distributing panel for 2300 volt circuits is located on the other side of the bench board, as are also the exciter panels and the Tirrill regulator.

The transformer equipment consists of three single phase 1,000 kw., 2300/400 volt, oil-insulated, water-cooled, step-down units for paper mill service.

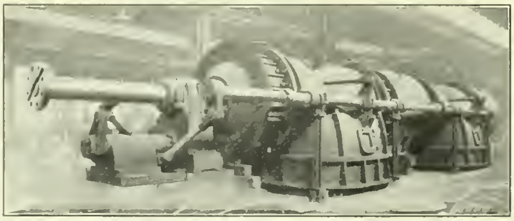
The Motor Room and Pulp Mill

A fine example of the increased efficiency and flexibility of large water wheels direct-connected to generators transmitting power electrically to motors direct-connected to their load, over the old method of driving each group of machines by a separate small water wheel of doubtful efficiency with its usual supplement of belts, countershafts, etc., is well illustrated in the new pulp mill recently placed in service by the E. B. Eddy Company, of Hull, Quebec.



Turbine Runners, with steel plate buckets.

The Eddy Company realizing that their old pulp mill, in which each pair of grinders was driven by an individual water wheel, was very inefficient in the use of water, decided to discard it and erect in its place a modern hydro-electric plant. By so doing they could secure a better head of water and use units of high efficiency and transmit the power electrically to a new pulp mill in which the grinders were direct-connected to motors, also of high efficiency. The wisdom of this course has been quite evident by the increased output of the grinders and the saving in water used on the water wheels. Three 4,500 h.p. units installed in the power house have replaced 31 water wheels which were used in the old pulp mill and nine stones are now producing more pulp than 18 stones did when installed in the old mill, due to the increased power and better speed regulation.

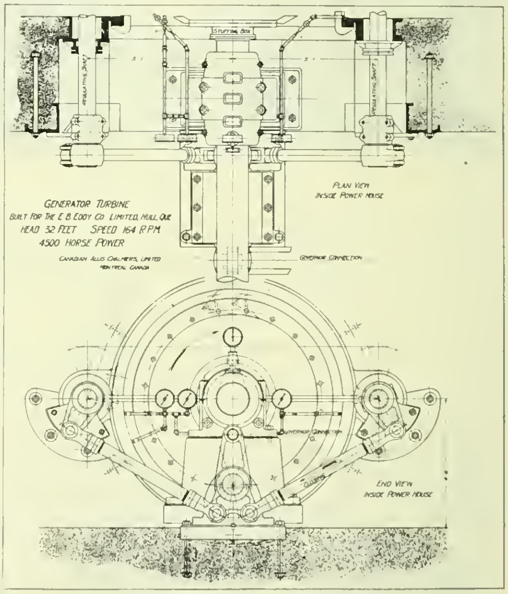


Turbine under construction.

This new pulp mill is of structural steel and concrete, approximately 180 feet long by 130 feet wide and to give some idea of its size it might be mentioned that 400 tons of steel and 36,000 bags of cement were used during its erection. The mill is practically divided into three long rooms each 180 ft. long by 40 ft. wide, the motor room being partitioned off from the mill proper in order to keep out the moisture which is always present in a pulp mill.

The mill is designed for five main grinding units, each unit consisting of one 1,200 h.p. type "HF" 2,200 volt, 233 r.p.m. induction motor located in the motor room with the shaft extended through the wall into the grinder room where it is direct-connected to three 3-pocket New England grinders with stones 26 ins. x 54 ins. At present there are four such units installed, except that on one grinder a 34-in. stone is used to grind any wood that is too long for the 26-in. stones. Each motor is controlled by a four-panel black marine slate switchboard on which is mounted a main oil switch, ammeter, two relays and six starting switches for cutting out the secondary resistance of the motors. This switchboard is located directly opposite the motor it controls which makes a very simple and compact layout. An ammeter is also placed in the grinder room on each unit so that the operators of the grinder may see the load they are putting on the motors.

Provision is also made for two refiners, consisting of three stones on one shaft direct-connected to one 200 h.p. type "HF" 2,200 volt, 290 r.p.m. induction motor. The motor is placed in the motor room with the refiner connected to an extension of the shaft in the grinder room. At the present time one such set is installed. In the motor room there is also placed three 300 kw. 2400/440 volt transformers and switchboard to control same for supplying the smaller motors around the mill.



Plan and section showing turbine control.

All of the electrical apparatus in the motor room is operated from the Eddy Company's new power house, about 800 feet distant, through five 450,000 circular mil 2400 volt cables.

In following the course of a stick of wood from the butting mill through the pulp mill to the paper machines it is interesting to note that outside the time it is barked and when placed in the grinders it is not touched by hand till it is made into finished paper in the paper mill. The wood goes first to the butting mill where it is sawn into two-foot lengths and from there it is taken by a conveyor to the wood room where are installed three Waterous barkers. The bark is here taken off and the wood is then dropped into a water

tank and from there it floats in concrete troughs to the grinders. After being ground into pulp it is pumped to the centrifugal screens where the slivers are taken out and from there the good pulp runs by gravity to the slush vats where the excess water is taken off. This white water, as it is called, is used again on the screens and grinders. After the excess water is taken off the finished pulp flows to the storage tank, which has a capacity of 75 tons dry weight—and from there is pumped by centrifugal pumps through two ten-inch pipes direct to the beating engines. The slivers that are taken out at the screens are not wasted but flow back to the refiners where they are re-ground and pumped back again to the screen and in turn find their way to the paper machine. The white water is filtered by three save-alls and the good pulp pumped also to the storage tank.

The capacity of the mill at present is about 85 tons of high grade pulp every 24 hours, but when the fifth unit is installed it will be about 105 tons per day. This capacity is figured when the grinders are making a very high grade of pulp and could be increased greatly if a coarser grade was tolerated.

In the wet machine room there are installed eight wet machines which make the pulp into laps for storage purposes.

The small motors in the mill are all wound for 440 volts, three-phase and fed from the main 440 volt switchboard in the motor room. All wiring is in conduit and each motor has its own starting panel close to the motor it controls. The electrical work throughout the mill has been installed in a first-class manner and is practically moisture proof. The coils of the motors have been specially impregnated and are also moisture proof.

The following is a list of motors installed and their connected load:—

H. P.	Syn. Speed	Type.	Connected Load.
1200	240	"HF"	Direct-connected to three 3-pocket New England grinders
200	300	"HF"	Direct-connected to refiner with 3 stones on one shaft
100	514	S. cage	Direct connected to countershaft for 8 wet machines
85	1800	S. cage	Direct-connected to centrifugal pump for grinders
75	514	S. cage	Direct-connected to countershaft for three centrifugal screens (mill designed for five screens)
60	720	S. cage	Direct-connected to centrifugal pump for pumping pulp from grinder pit to screens
40	1200	S. cage	Direct-connected to centrifugal pump for pumping pulp from storage tank to heaters—about 800 feet
55	720	S. cage	Direct-connected to countershaft for 3 barkers
50	1200	S. cage	Direct-connected to centrifugal pump for pumping water to wet machines
40	1200	S. cage	Belted to 14 slush vats
30	720	S. cage	Direct-connected to centrifugal pump for pumping white water to screens and grinders
30	600	S. cage	Direct-connected to centrifugal pump for pumping pulp from save-alls to storage tank
25	900	S. cage	Direct-connected to fan for blowing shavings from barkers to boiler house
20	514	S. cage	Direct-connected to centrifugal pump for circulating water in wood troughs
15	720	S. cage	Connected to three save-alls by countershaft

The electrical apparatus in the motor room as well as the exciter generator was supplied by the Canadian Westinghouse Company; the turbines by Canadian Allis-Chalmers, and the main generators by the Swedish General Electric, Limited. L. A. Herdt and William Kennedy, Jr., were consulting engineers.

The Canadian Laco-Phillips Company have closed a contract with the Robert Simpson Company of Toronto for 500 units of 500 watt capacity each, nitrogen filled tungsten lamps. These will be used in connection with semi-indirect lighting bowls which are being supplied chiefly by the Jefferson Glass Company. The Macbeth-Evans Company are supplying glassware for the ground floor.

Private Branch Exchange Switch Board

On July 18 a No. N4-D type private branch exchange multiple switchboard in the new Canadian Pacific Railway station was put into operation. The apparatus consists of six one-position sections and one cable turning section; each position is equipped with seventeen pairs of cords and double supervision. The line equipment consists of two hundred lines, with an ultimate of four hundred and twenty lines, thirty incoming trunks, and an ultimate of forty, also thirty outgoing trunks, with an ultimate of eighty lines.

The arrangement of the subscribers' multiple permits of a most rapid operation, being multipled every three panels; every line is within easy reach of each operator; all lines, with their corresponding line signals, appear four times in the multiple; therefore any one of the six operators may answer or call every station; if necessary the traffic loads can be distributed to each operator by the insertion of colored lamp caps. The illustration shows the switchboard in operation.

The house and outside lines are brought into the apparatus room in two three hundred pair lead covered cables, and carried into the intermediate distributing frame in four one hundred and fifty pair cables, where they are formed out to their respective terminal strips, and connected with jumpers to the cabling to the switchboard; adjacent to the

Multiple six-position switchboard, new C.P.R. Station, Vancouver—the largest of its kind on the Pacific Coast.

intermediate distributing frame is placed the line and trunk relay, also repeating coil, racks, etc.

The power plant consists of two sets of seventeen cells each of type D-7 Electric Storage Battery Company's batteries, charged with a motor generator set, consisting of a 110 volt, 60-cycle, single-phase, 1800 r.p.m. alternating current motor, and a 7½ ampere, 45 volt direct-current generator, mounted on a suitable machine table. The ringing generator is supplied from an 80 volt generator, direct-connected to a ⅛ h.p., 110 volt, 60-cycle, single-phase, 1150 r.p.m. alternating current motor; the whole power apparatus is controlled by the necessary switches, circuit breaker fuses, volt and ammeter, mounted on a specially designed Monson, Maine, slate panel.

The equipment was manufactured and supplied by the Northern Electric Company, Limited, Montreal, and installed by the British Columbia Telephone Company's Switchboard Department.

A rejuvenation of the Sons of Jove, Montreal, will be held on September 15.

Aluminum-Cell Lightning Arresters

By E. E. F. Creighton

Although the aluminum-cell lightning arrester is now many years old in practice, there is available in the Transactions of the Institute very little definite scientific information on this subject. It has seemed preferable to produce certain results rather than describe beforehand how such results were to be obtained. The practice of the aluminum arrester has now settled down to definite sets of conditions, and it is the object of this paper to consider standard conditions and open up the subject to discussion. Aluminum lightning arresters will be treated in general on points that may seem debatable. No detailed description of apparatus will be given herein.

The question is often asked—Will certain types of arresters be superseded? In very few cases has it been possible to give a definite answer to such a question, owing to incomplete knowledge of cloud lightning phenomena. It has been possible to say that if future investigations of cloud lightning prove that every lightning stroke is of high frequency and steep wave front, certain changes would come about under these conditions; it would be possible to prophesy, with considerable confidence, that many types of lightning arresters now in use would disappear. The natural growth of protection would be along the line of various types of high-frequency absorbers.

If, on the other hand, it should be shown that lightning is always of low frequency, and gives the surge a sloping wave front, then again, it would be fairly safe to prophesy the contrary—that very few of the lightning arresters now in use would disappear, and that probably no other devices would take their place.

Recent investigations of lightning phenomena have confirmed our views that cloud lightning has wave fronts of various degrees of steepness, and without question some of the lightning strokes are not high-frequency effects but are of the nature of simple impulses. The writer's recent experiences along this line have been gained by indirect methods. Lightning arresters have been put out which were sensitive to very high frequencies, and at high frequencies had very good protective qualities; but at very low frequencies their spark potentials were greater than at high frequency. Other arresters equally sensitive to both high and low frequencies have been installed in the same locality. This experience has indicated that many of the strokes are of low frequency. The most valuable and practical investigation of lightning arresters that has yet been made on a large scale has been carried on by Mr. D. W. Roper, and no doubt these results, which are incomplete at the present time, will be made available at some later date. More direct measurements of lightning taken with an oscillograph have been made by Mr. L. A. De Blois. These, I believe, are the most valuable direct tests that have been made in many years. I am personally indebted to both Mr. Roper and Mr. De Blois for information on their researches, and I understand that their valuable work will be presented to the Institute at some future meeting.

In the development of the present standard arresters our knowledge of lightning gave us no alternative but to assume that lightning had all the characteristic qualities of the various surges that could be produced in the laboratory. For example, we have assumed:

That the frequency might be from zero to 5,000,000 cycles per second.

That the wave front might be either vertical or angular.

That the quantity of electricity was both large and small.

We have known from our earliest investigations that several strokes came in succession. It was also necessary to take into account the effects of the energy from the generator which followed the lightning discharges. In this way we have endeavored to be prepared to meet any new information that might come concerning lightning strokes. Naturally, all these different factors could not be given equal weight in the design, and therefore, as more definite information regarding the nature of lightning is obtained, the designs will be strengthened in the features that these investigations may show are weak. It is a matter of increasing the ultimate efficiency by a small percentage.

The direct-current aluminum arrester is practically ideal from the standpoint of protection. It has no series gap and therefrom it gains two valuable characteristics: the first of these is the elimination of any dielectric spark lag; and the second is the absorption of high frequencies which have a less potential than the circuit potential. Commenting on these two conditions, the dielectric spark lag, although it is ever so small, is still appreciable as compared with the time of movement of a surge along overhead lines. A surge will travel a mile in about five millionths of a second. If the surge is a mile long, and the dielectric spark lag is five millionths of a second, such a surge will have passed along the line without starting a spark across the gap. The only means of discharging such a surge would be by introducing a choke coil in its path and thus delaying its movement sufficiently to allow the spark gap to become ionized. Since the spark gap of the a.c. aluminum arrester has a setting which may be only 25 per cent above the line potential, high-frequency surges can be deflected into the arresters if the potential either of the surge or the superposed value on the 60-cycle potential reaches the spark value. If the generated potential happens to be zero at the instant, it is evident that the surge itself must have a value 25 per cent above normal in order to cause the arrester gap to spark. The d.c. aluminum arrester, by its direct connection, is able to pick up surges of all frequencies and all potentials immediately on their arrival at the terminals of the arrester.

The practical demonstration of the protection afforded by these d.c. aluminum arresters confirms the theoretical work and experimental work tests made on the cells. The discharge rate at double potential is more than a million times as great as the leakage current at normal potential.

Cost vs. Economy

From a practical standpoint, the cost of such arresters must be considered. While the cost and upkeep of the d.c. aluminum arrester is greater than for the older types using gaps and series resistances, still the aluminum arrester is the more economical one to use. The higher protection given by the cells would justify some increase in expense on account of the better service that can be maintained. But, as a matter of fact, the actual expenditure for the protection as a whole becomes less, due to the fact that good protection on the cars makes a less demand for the use of arresters along the trolley line. The saving in the cost of line arresters will more than compensate for the extra cost and upkeep of the aluminum arrester. Moreover, even with the very best types of gap arresters on trolley cars and trolley lines it is impossible in lightning-infested districts to maintain the car service. The percentage of protection from the gap type of arresters is not high enough even when the best arrangement

of wiring and choke coils is used in conjunction with the arresters.

There is one further function of the d.c. aluminum arrester that has considerable value, and that is the absorption of electro-magnetic surges coming from the interruption of accidental short circuits on the trolley line. Such high potential across loaded motors has a tendency to cause flashing around the commutators. If the flashing around the commutator is caused by the excess potential, then the d.c., aluminum arrester will relieve the trouble.

Answering, then, the frequently asked question—Will the d.c. aluminum arrester be superseded?—the answer is, in principle, no. Improvement in details may be made, and there may be discovered some new and better substance than the aluminum film, but none is yet known. Any degree of protection that is desired at its terminals can be obtained by the use of this arrester. An improvement in the length of life of the arrester is desirable, but this will not be superseding it. The discovery of some new substance that will give the same electric valve effect at a definite voltage only slightly above the operating voltage would be no particular improvement, unless perhaps it might be something that would not deteriorate when left disconnected from the circuit.

Turning next to the a.c. aluminum arrester, it was found impracticable to maintain simplicity and long life in the arrester and at the same time keep the arrester directly connected to the circuits. For this reason the horn gap was introduced in series with the aluminum cells. Since the hydroxide films on the aluminum plates gradually dissolve in the electrolyte it becomes necessary to introduce a method of charging the cells. The simplest method was first tried: it consisted of bringing the horns near each other and reducing the gap to a very small value. Many trial installations were made under these conditions and no bad effects were obtained. When the number of arresters in use ran up into the thousands, then an occasional trouble resulted from the rush of current into the aluminum cells.

The aluminum cells are condensers and as such will take initially a considerable rush of current. Furthermore, the dissolution of the aluminum films required a considerable quantity of electricity from the line to reform them. Where the films had been subjected to unusual dissolutions either by standing in hot electrolyte, resulting from atmospheric temperature or long periods of discharging, or from neglect to charge, the current rush into the aluminum cells became a serious menace, mostly to the arrester itself. Since there is no external indication of a bad condition of the aluminum cells, even an expert would be unable to know if it were permissible to close the charging gap of the arresters. This led naturally to the use of charging resistances in series during the ten seconds a day needed to charge the arrester. The charging resistance is an added expense and an added complication. But the added complication is relatively small, and the all-around increase in the safety of the arrester is great enough to justify both the cost and complication, from the user's standpoint.

Surges Accompanying Charging

The subject of possible surges accompanying the charging of aluminum arresters is one far more pertinent in an article written for foreign readers than in one for American engineers. The foreign operators seem to have had misfortunes with their arresters that have not been duplicated in America. The reason for this might be attributed to a number of different causes, depending upon the country and the localities. These reasons might be enumerated as methods and care in manufacture, the lack of definite and emphatic instructions to operators, poor distribution of insulation in transformer coils, and difficult situations caused by any one of several factors, such as, for example—high temperature, bad regulation of the line, and insufficient care after an arrester had been called on to discharge continuously during an accidental ground.

The general results from any one or more of the foregoing enumerated factors may be classified under two heads: first, a short circuit in the arrester and consequent interruption on the line; and second, surges set up on the line without any damage to the arrester. Nearly all these conditions can be rendered harmless by the use of charging resistances. The one important exception is the matter of bad regulation of a line in which the power voltage is allowed to rise to values above the spark potential of the arrester. Under these conditions of discharge the arrester is no longer being used as such, but rather as a rheostat to absorb the generated power. The arresters cannot, at any reasonable expense, be designed to act as rheostats. While it might, in special cases, be possible to develop arresters which would withstand these conditions, the better solution of the problem is to improve the regulation. If care in manufacturing the aluminum plates and the electrolyte is not taken, and the installation made free of dirt and impurities in the electrolyte, more or less deteriorated conditions will exist throughout the life of the arrester. Certain kinds of impurities have a strong destructive effect on the films. A condition of unusually high operating temperature may call for an electrolyte especially adapted to high temperatures, or it may simply be taken care of by charging two or more times a day. Dissolution of the film from standing in hot electrolyte after the arrester has discharged continuously for a number of minutes can cause no trouble if a reasonable charging resistance is used, as the series resistance limits the current to a value which will not damage the arrester. With the exception, then, of high generator potentials from bad regulation of voltage, there is no difficult problem connected with the use of aluminum arresters.

A discussion of the aluminum arresters would not be complete without some reference to the possible surges that may be set up by the charging of the arrester. Surges on an electrical system may be considered in a list of ascending degrees of severity. Turning on an incandescent lamp sets up an electric wave on the system by calling on the generator for more power. A surge of this kind is of the third order of importance, and therefore, entirely negligible. It is well known that any spark or arc in the circuit containing inductance and capacity tends to set up oscillations, but if the resistance in series is equal to, or greater than, the critical resistance, oscillations will be prevented.

It is common practise to-day to open and close circuits which contain inductance and capacity without introducing in series a resistance to absorb the transient surges that are thereby set up. It is also common practice to-day to use circuit breakers to open accidental short circuits in which there is a high value of surge energy, and sometimes high voltages.

Going still a step further, every circuit is subject to accidental arcing grounds, which produce continually on the circuit dangerous surges which are often but slightly damped. It is difficult to protect apparatus from these most severe conditions of surges. In general, however, apparatus is built to withstand severe treatment, and there is but a small percentage of loss. Therefore, when we come to consider surges on the system we should take into account the conditions of insulation in relation to the severity of the surge.

Where Should Arrester Be Placed?

In all these graded degrees of severity of surges, where should the aluminum arrester be placed? If there were a demand for it, the arrester could be placed in the list next to the negligible surge of connecting an incandescent lamp

to the circuit, and this could be accomplished by using graded resistance in charging. In view of the insulation of the apparatus that is needed for the usual condition of operation and to withstand the inevitable accidents which cause severe surges from time to time, the use of graded charging resistance would be a needless and inconsistent precaution. It is sufficient to say that it could be done if it were desired.

What is actually done is more reasonable. A relatively large value of resistance is used in the charging circuit, limiting the current to a range of 5 to 15 amperes. Charging resistances are an intrinsic part of aluminum arresters as now manufactured. Strong recommendations have been made to operators to add them to their older arresters. A characteristic answer is to the effect that "our arresters have been charged through a gap for six years without trouble, and we are satisfied." The change is brought about not by reason of surges, unless they cause telephone interference, but rather on the ground that the arrester is made more immune from damage to itself.

In foreign countries, with their water jets and resistance types of arresters, the controversy over arresters still waxes as warm as it did here in the formative period some eight or ten years ago. The following argument is advanced against the aluminum arresters: admitting that the charging resistance does away with the surges, what about the heavy strokes which cannot pass through the charging resistance and therefore jump the main gap directly into the cells to ground? To anyone familiar with the practise here up to 1913 an answer is unnecessary. If this discharge path were a menace, devices could be used to mitigate it. The nature of the menace can be understood by a review of the past practise. There are several thousand aluminum arresters in use that have been charged through a gap without series resistance. Good practise now condemns the method, but there it is. Ten seconds' charge a day produces over a thousand makes and breaks. There would therefore be more than a million total made per day and more than a billion in a few years. Judging by the rare cases of trouble in this vast number it cannot be much of a risk to allow a few discharges per year to pass directly to ground through the aluminium cells, especially in face of the fact that such a surge is so dangerously large that it cannot be relieved through the resistance, and therefore the surge itself is an undoubted menace to the insulation as it runs wild over the electrical system at 186,000 miles per second.

The status of the aluminium arrester, therefore, is that of a device founded on the solid principle of a safety valve. It has definite limits of maximum current discharge rate and of energy absorption, beyond which damage to the arrester will result. In this respect it is no different from other standard apparatus. Years of experience have demonstrated that these limits are far above the usual demands of practice, but naturally it is not impossible to pass them. The flexibility to meet special conditions is great. Film area, internal resistance, relative gap settings, external resistance —all are readily adjustable to the demands which may possibly come as our knowledge of lightning and other surge phenomena is increased.

Discussion

V. Karapetoff: I would like to ask Dr. Creighton whether he has had any experience with the glass condensers and valves made in Switzerland and known there as the Moscicki condensers and Giles valves.

F. W. Peek, Jr.: It is some time since I have been actively connected with work on the aluminum lightning arrester. A number of years ago I had the good fortune to be able to make a study of lightning and the operation of the aluminium arrester on a practical line in Colorado. We had the co-operation of one of the operating companies in the experiments on this system which was high up in the mountains. It was 17,000 volt network and a 50,000 volt main transmission, with a 50,000 volt idle line upon which to experiment. Various forms of lightning arresters had been tried by this company without success. It was practically impossible to continue operation during a storm. At this time the aluminum arrester was very new and we did not intend to make use of it as a practical protection; our idea was to make a study of lightning itself. However, in an attempt to improve operating conditions it was decided to install a few aluminium arresters. These arresters could not be obtained from the factory at that time. It was a very difficult country to get into. A sufficient number of aluminum cones was obtained, however; containing tanks were built in the mountains, and the electrolyte was compounded from chemicals bought at a local drug store. An arrester was thus built up and put into operation, and it did very good service. It was decided to install a few more. At a later period in the season these were obtained from the factory and were distributed to various sub-stations. During the latter part of that season there were very severe storms and very little trouble. Many improvements have since been made in the arrester, notably in the electrolyte and in the addition of charging resistance.

The aluminum arrester is the only arrester at present that can take care of a condition of high-energy lightning discharges of moderately steep wave front or moderate frequency. This is often the only condition; generally the prevailing one that must be met. Good protection is thus obtained in the majority of cases with an occasional miss during the season. There are certain conditions, generally in the minority, but which occasionally on a few systems are the prevailing ones, which no arrester with a gap can, unaided, satisfactorily take care of. These conditions are:

1. Lightning impulses of exceedingly steep wave front and high voltage.

2. Impressed high frequency of a voltage insufficient to discharge the gap.

In condition (1), the dielectric breakdown time lag of the gap may prevent discharge of the arrester before discharge takes place at some weak point in the system.

In condition (2), discharge does not take place at the gap because the voltage is not high enough, but the oscillations may build up high voltage internally in an apparatus containing inductance and capacity.

Both conditions, (1) and (2)—which may be considered as more or less special—may be taken care of by the proper arrangement of resistance, inductance and capacity.

Good engineering requires as high system insulation as is economically possible, with the weak point at the lightning arrester.

L. C. Nicholson: Electrolytic lightning arresters are coming to be very widely used, and I think by this time they are recognized as the standard type of station arrester.

Frequently the question is asked—Are they efficient? Are they necessary? We operating people reply by saying, "Yes, they are necessary, if you think so," the result being that most of us are afraid to leave them off. As far as I am acquainted with the operating results of this type of arrester, there is seldom any apparatus damaged when protected by such an arrester, and I will also say that when the apparatus is not protected by such an arrester, there is very seldom any damage. So it appears that the arrester is all right. Except on extremely highly insulated transmission lines, damage to high-tension apparatus in the station by lightning is rare.

Usually lightning effects are so localized that the line has its own trouble and keeps it. I am acquainted with an installation which uses a pretty wide gap between the line

conductor and earth, say 100 per cent. over voltage, which discharges once a year, and which seems to be about all the protection that the station apparatus really needs, judging from the fact that no station apparatus has been punctured. I am acquainted with other stations which have electrolytic lightning arresters and which are not troubled by lightning, and I am acquainted with some which have electrolytic lightning arresters and are troubled by lightning, so that it is very much of a question as to whether lightning will or will not do damage under certain conditions of station protection.

At least, the aluminium electrolytic lightning arresters have been developed to a point where there is no longer any danger of their exploding or giving any trouble on their own account if properly cared for, and the usual station attendant, with sufficient instructions, can properly care for the arresters and keep them in proper service. I feel sure that the addition of charging resistance has been of great benefit to the operation of this arrester.

The pity is that these arresters cannot extend their influence beyond half a mile from the station. In most cases the trouble is beyond that point.

C. O. Mailloux: Reference has been made to the character of the "front" of the wave which strikes a line or a portion of circuit protected by lightning arresters. It is known that the vertical front of a wave may be flattened out and sharpened to a point, so to speak, in passing through a reactance. It would seem therefore, as if one might expect that the character of the wave-front would depend somewhat upon the distance from the apparatus at which the lightning strikes the line. One might expect that the lightning striking the line very close to the lightning arresters would produce a current-wave having a squarer, straighter front, a more vertical one, than if it struck at some distance, owing to the difference in line-reactance. It may be that in most cases this would not make much difference. In any case, it should be possible to alter the wave-front, to some extent, by the introduction of artificial reactance.

C. P. Steinmetz: I wish to refer to only a few features. Setting aside failures of insulation due to weakness of poor design of bushings, insulators, etc., it occasionally happens that even a good lightning arrester fails to protect coils of transformers. The explanation of this is a feature which I have endeavored to make clear in my paper. These failures mean merely that when we speak of lightning we do not know the nature of the surge, and it is necessary to make such studies as will determine it—why at times the surges cause damage and other times they do not.

The aluminium arrester, with a gap in series, may protect against any surge which reaches the aluminum cells. Any disturbance of a voltage less than that which will jump the gap and thus reach the aluminium cells naturally cannot be absorbed by the aluminum cells. Therefore, if we have a high-frequency oscillation of a voltage sufficiently low not to jump the spark gap and incidentally sufficiently low not to do any damage to the line, such a voltage may not be able to do harm to the insulation from line to ground, but when massing of the surge occurs in a few turns of reactance such as a single coil of a transformer, it may do very great damage because, while the apparatus is designed to stand the line voltage, it is not designed to stand half the line voltage across say one-hundredth or one-thirtieth of the circuit. The main trouble, due to high frequency, comes from the local massing of voltage across the reactance.

In speaking of high frequency we may refer to various different effects, and we also usually mean a thing which is not high frequency at all, is not even oscillation—it is steep wave front. A steep wave front, to some extent, causes the same trouble, namely the same massing of voltage, but in other respects it is very different. Some types of protective devices, like the multi-gap arrester, are very sensitive to high frequency, and will discharge high-frequency surges of voltages much less than the operating voltage, but they are not sensitive to steep wave front and may allow steady voltages of steep wave front to rise far above the circuit voltage without discharging.

Another illustration of this difference is given by the application of a condenser. Where there is very high frequency, a condenser shunted from line to ground may bypass or practically short-circuit the high frequency, but where there is an uni-directional wave the condenser will take a charge and thereafter offers no obstruction to the rise in voltage.

We must realize that electrostatic capacity is not a lightning-protective device—is not by itself a protection. A capacity from line to ground merely is a thing which will charge and store the energy. The storage is transient and the energy in the condenser must be returned to the circuit. Thus the condenser in the line will have no effect at all on steady voltage, or on low frequency. The favorable action the condenser can have is apparently to short-circuit disturbances of relatively high frequency.

Such disturbances, in my opinion, are rare, if they exist at all on transmission lines. For the reason that the capacity of the transmission line is so large, compared with the capacity which can economically be provided for in a condenser, any small condenser which can be shunted across the lines at the station would not be capable of appreciably short-circuiting the surge. Thus the high-voltage and the high-frequency disturbances of such volume and such current as can come in over the line are not cared for by any condenser of practicable size.

It is different when the surge comes from the other direction—that is, where the high-frequency disturbance comes from the station. In the transformer, as in the line, the circuits have distributed inductance and capacity, but in the transformers the inductance is very much greater, and the capacity very much less than in the line, and therefore the ratio of voltage to current of the disturbance is very much greater. In other words, capacity has an appreciable effect on a traveling wave, when the capacity is shunted around the high-potential windings of the transformer.

The value of capacity in protective devices lies in the fact that it is a barrier against the passage of current at machine frequency without being a barrier to the passage of surge currents which are inherently of high frequency. Under these conditions it is possible to use a resistance of low value in series with the condenser without absorbing any appreciable power at machine frequency. At high frequency, however, the power factor approaches unity and the maximum possible energy of the surges is absorbed. Thus it is seen that it is not the capacity in itself that is protective, as the voltage absorbed by the capacity at high frequency is negligible, but it is the capacity allowing a properly proportioned resistance to give protection by absorbing the energy of the wave.

This is the condition in the aluminum electrolytic cells, where there is a high equivalent resistance in series with the natural capacity of the cells.

The capacity of the aluminium cell gives a moderate power factor at average machine frequency, but when there is applied a frequency of 100,000 cycles, the power factor of the aluminum cell is practically untiy, that is to say, practically all the high-frequency current which goes through the cell is dissipated as energy and does not store itself as energy to be turned back into the circuit, as would be done by a simple capacity.

I believe that the action of the aluminum cell can best be represented by calling it a counter-electromotive-force device. It acts as a counter-electromotive-force shunt between

circuit and ground after the voltage has reached a definite value. Up to this definite value, i.e., discharge voltage of the spark gap, it is an open circuit, and beyond that voltage is a closed circuit. In the closed circuit condition it has about the same effect as if in a d.c. system you shunt a storage battery from the trolley wire to the ground. If you connect between the trolley wire and ground a 600-volt storage battery, then no lightning or any other disturbance will be able to raise the voltage of that trolley line appreciably above 600 volts because any attempt to raise the voltage would merely cause a discharge through the storage battery. The discharge rate depends on the internal resistance and voltage above the polarization of the storage battery; so it is in the aluminium cell, where the discharge rate depends on the voltage in excess of the polarization value and on the internal resistance of the cell, which, as we all know, is very low.

Now, as to the possible danger from the use of the aluminum cell, which has been especially discussed by those who have had very little practical experience with it—that is, the question whether it may produce high-frequency oscillation. One argument against the production of high frequency I have mentioned already the power factor of the aluminum cell is unity and it has no capacity effect at high frequency, but it gives a thoroughly damped circuit of a resistance which prevents oscillations. But from another view-point, the best comparison is that given by Professor Creighton—it is a safety valve from line to ground, of very high discharge rate.

We would not think of installing a high-pressure steam boiler without a safety valve, and still, many of us know that every once in a while you hear that a safety valve is really a source of danger, because if a steam boiler is superheated, and water is low, and just at the point where it is near blowing up, and if the safety valve operates, then the sudden shock of the safety valve opening may set off the explosion. But that is no reason for saying that it is unsafe to use safety valves and that all the steam boilers should be operated without them. It is exactly the same case with the aluminium cell or any protective device. If you protect the system against over-voltage, and if the energy back of the over-voltage is very large, it means that to relieve the over-voltage strain we have to provide a device with a high discharge rate, and the sudden coming into play of that high discharge rate, which is required to relieve the strain, means a sudden shock to the system, and if you are near the breakdown point, that very shock may cause a breakdown.

But it has been said that it is not necessary to have a free discharge, and that a resistance may be inserted between line and ground—a critical discharge resistance which will gradually relieve the voltage without oscillations. That is very nice. By so doing the shock is rsemoved only by keeping the excess voltage on the line and the apparatus for a considerable time, and for the time, in fact, that it takes to discharge, and since the disruptive strength depends on the time of applied voltage we wish to relieve, we must conclude that we are between two extremes. We have a condition of excessive voltage brought on by lightning or other disturbances. This voltage is dangerous, is certain to destroy apparatus and line if it stays long enough. We may gradually relieve, or we may suddenly relieve, but since the voltage is certain to destroy, the most effective way is to relieve it as quickly as we can, even if in the extreme case the very suddenness of the relief may accelerate the damage, which is, however, very improbable. I do not know of any instance where this has occurred, and I think the point raised in this connection is more theoretical than actual.

There is one point I want to mention about steepness of wave front. The steepness of wave front depends on the distance of the place from the point where the wave originates. Theoretically, if you calculate transient phenomena of the line, you will find, by an equation, that the wave shape is so steady that the wave starting as a steep wave front retains its steep front all over the line. Practical experience shows that this is not so, and that is one of the various points where theory and calculation do not agree, or where, in our theory, we make an assumption which we find is not warranted—that is, we assume the effective resistance and effective conductance to be constant, independent of the frequency, while in reality every decrement increases with increase in frequency.

If you assume that the effective resistance of the line is a function of the frequency, increasing with increasing frequency, then you would find in the equations (if the equation did not come out so complicated) which so far have been beyond the mathematical skill brought to bear upon them, that the steepness of the wave form decreases with increasing distance traveled by the wave.

But while the equations have not yet been solved to give the values of the increase in resistance of the line, experimental evidence is available. There were some very interesting tests, for instance, made by Mr. Faccioli some years ago, on the wave produced by opening the high-tension switch in a 90,000-volt circuit. In that case, at and near the point of opening of the switch, the steepness of the wave front was such as to give, across a choke coil the inductance of which was equivalent to 50 feet of line, a potential difference of 30,000 volts, but the same size of coil on the same line at 20 miles distance, gave no appreciable steepness of wave—that is to say, in the switching test there was no discharge on the spark-gap shunted around this small reactance. Within 20 miles of travel the wave front changed from an extremely steep one to a very flat one. This is the experimental evidence of the high-resistance offered by the copper line wire when the potential is suddenly applied.

E. E. F. Creighton: I feel that there is no need to say anything further about the Moscicki condenser, in answer to Dr. Karapetoff's question, as Dr. Steinmetz has already covered the subject.

I am glad that Mr. Nicholson has thrown a little spice into the controversy by speaking of the cases where apparatus was not damaged and the arresters were installed, and also cases where the apparatus was not damaged and the arresters were not installed. Each one of us speaks from his experience, especially his own personal experience, and Mr. Nicholson, I take it, is speaking from his. If I may be permitted, I would like to analyze some of the conditions under which he has been operating and then contrast them with some other experiences which have been gained on other transmission lines where the conditions are different.

On that particular system to which Mr. Nicholson referred there was, a few years ago, an almost insurmountable problem of keeping the lines operating during thunderstorms. I have the greatest admiration for the way in which Mr. Nicholson has attacked this problem and obtained a workable solution. The point of it was that the insulators on the line had not only less factor of safety than they needed, but they punctured, and where every insulator on the line is a lightning arrester it is quite true there is less need of lightning arresters in the station. Under these conditions the principal need of a lightning arrester in the station is where the lightning happens to strike in the neighborhood, and that, I think, corresponds to Mr. Nicholson's remark that it is too bad the lightning arresters cannot reach out more than a half-mile from the station. I should say that it is too bad the lightning is so terribly concentrated at points on the line. That represents to my mind the experience gained in that particular case.

On two other lines I know of, where the insulation of

(Continued on page 51.)

Present Status of Prime Movers

A Very Valuable Report on the Latest Developments—Summary of Investment and Fuel Cost. (Continued from Aug. 1.)

By H. G. Stott, R. J. S. Pigott and W. S. Gorsuch.

zontal, single or multiple, material in runner, which may be made of cast iron, cast steel, gun metal, bronze, etc., depending upon the service conditions, are some of the factors that cause the price and weight to vary materially. With a given head, the greater the power of the turbine the less the unit cost. With a given head and power, the higher the speed the less the unit cost. On the other hand, with a given power, the lower the head the greater the unit cost. For illustration, a water turbine developing 50 h.p. under a 30-ft. head, and costing $18 per h.p., will develop approximately 300 h.p. under a 100-ft. head, and will cost only $3 per h.p., assuming other conditions equal. In reality the cost of the turbine under the 100-ft. head would be slightly higher than $3 as the construction would naturally be more expensive.

In general it can be said that the cost of hydraulic turbines and generators larger than 200 kw. capacity will vary from $30 to $10 per kilowatt installed, exclusive of foundations.

With the broader field now covered by turbine design and construction, the necessity for careful selection has become most important, and the hydraulic engineer can at the present time secure hydraulic turbines of the best character and design only by careful attention to the intelligent analy-

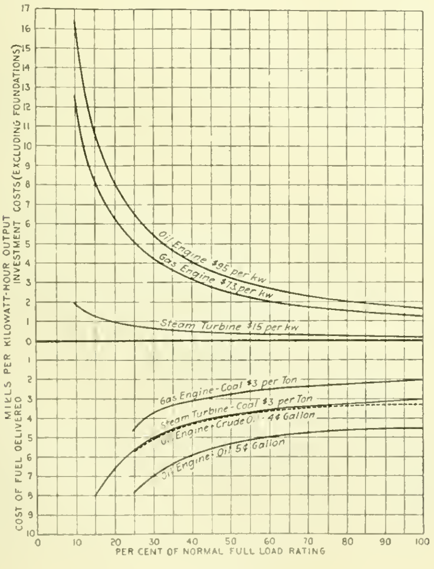


Fig. 16.

sis of turbine possibilities, and the selection of wheels suited to the particular conditions of head and load under which such turbines are to operate.

Finance and Economics

Investment and Fuel Costs.

(a). Heat Engines.—In comparing the various types of prime movers, conclusions are often reached, largely from a study of the cost of fuel, without any reference whatever to the total cost of power and the relative investment costs. As it is not within the scope of this paper to include operating and maintenance costs for the entire plant, investment costs of the units and fuel costs are shown plotted in conjunction with the percentage of normal full-load rating in Figs. 16 and 17, for making an economic study of the various types of prime movers.

The impression that gas and oil power invariably imply a lower cost of generation is constantly losing ground through the critical analysis of the elements of power costs.

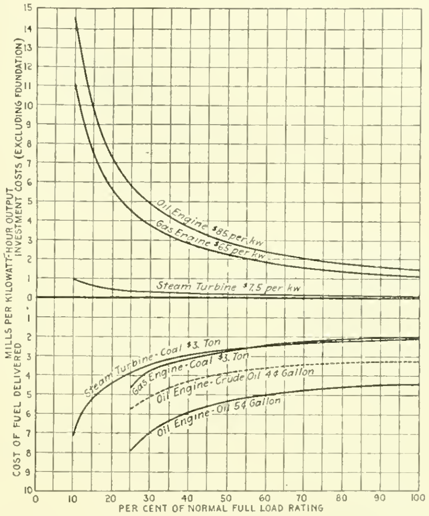


Fig. 17.

Fuel is only a fraction of the total cost of power, and there are conditions where it is overbalanced by other costs.

Claims have been repeatedly made that steam turbines use two and onef-half times the amount of fuel consumed by gas engines, but these statements are without foundation. Before any fair comparison can be made of fuel consumptions, records should be kept over a reasonably long period and the coal reduced to a common basis as to B.t.u. per pound and the percentage lost in refuse.

The curves plotted in Fig. 16 are for small machines of 750 kw. capacity—the steam turbine a single unit costing $15 per kilowatt, the gas engine a single unit costing $73 per kilowatt, and the oil or Diesel engine a double unit costing $95 per kilowatt. These prices are for the prime mover and generator delivered and erected (exclusive of foundations) within 600 miles of the factory.

The investment costs are taken at 11 per cent for the steam turbine and 15 per cent for the gas and oil engines. In investment costs are included interest, taxes, insurance and amortization fund, that is, an arbitrary percentage that should be set aside and the percentage corrected, if necessary periodically, so that when the apparatus is condemned on account of obsolescence or inadequacy, there will be a fund which will meet the expense (see "Power Costs" A.I.E.E. Proceedings, May, 1913).

Coal for both the steam turbine and gas engine is taken

at $3 per ton having 14,500 B.t.u. (3,654 large calories) per lb. delivered alongside the dock. On account of the wide fluctuation in price of the same oil at the same locality, two figures are used, namely, four and five cents per gallon. All auxliary costs are included, but stand-by costs are not, as these vary widely with the conditions of operation.

Adding the investment and fuel costs for any percentage of normal full load rating, the steam turbine will be found to be slightly less than the gas, and considerably less than the oil engine. Even with stand-by losses allowed, the turbine will still have the advantage over the gas engine loads below 80 per cent full load rating.

The investment costs are computed on the normal full-

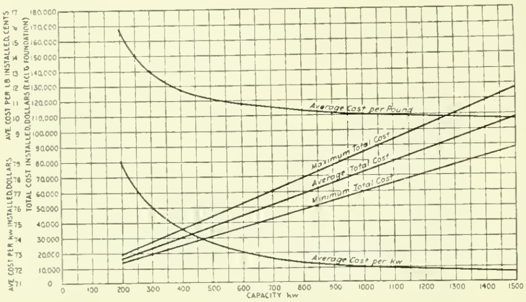


Fig. 18

load rating, and if advantage is taken of the overload capacity of the turbine which is approximately 25 per cent for 24 hours, the cost per kilowatt-hour during such periods of maximum capacity will be less than shown by the curve. This does not apply to gas and oil engines, as what little overload capacity may be allowed in these machines is for a short period of two hours or even less.

Another set of curves is plotted in Fig. 17, showing a single turbine unit of 20,000 kw. capacity, costing $7.50 per kilowatt, ten 2,000 kw. gas-engine units costing $65 per kilowatt, and forty 500 kw. oil-engine units at $85 per kilowatt. In a plant of this capacity the gas and oil engines are practically out of the running with these fuel costs.

In computing the cost of fuel the coal was put on the same basis, namely, 10,825,000 B.t.u. (2,727,868 large calories) per dollar, whereas the oil at 4 cents per gallon is equivalent to 3,718,000 B.t.u. (936,925 large calories) per dollar. This may look as though the steam turbine and gas engine were being favored but in comparing prime movers as they stand to-day they must be considered in connection with the prevailing cost of fuel. While it is possible to get a cheaper coal than $3 per ton with 14,500 B.t.u. (3,654 large calories) per lb., it is a question whether many more B.t.u.'s (large calories) of natural oil per dollar can be obtained, except in a few localities.

If natural instead of producer gas is considered it would cost about 10 cents per 1,000 cu. ft., which is a reasonable figure, as the price varies from 5 to 25 cents per cubic foot, depending upon the location of the well.

At 40 per cent of normal full-load rating the investment cost for the gas engine is approximately 90 per cent of the fuel cost and for the oil engine using oil at four cents per gallon it is about 80 per cent, whereas with the steam turbine it is only 7 per cent.

If we assume for illustration, that in a small plant it is possible to obtain a horizontal semi-Diesel installation, including engine and generator delivered and erected, excluding foundations, for $73 per kilowatt, and that oil can be purchased for 3.5 cents per gallon delivered, it will be seen from Fig. 16 that while the cost of fuel will be slightly in favor of the oil engine, the sum of the ordinates above and below the axis for any percentage of load will be in favor of the steam turbine. With larger installations it will be seen by referring to Fig. 17 that the turbine has decidedly the advantage.

All these illustrations are on the basis of the normal full-load rating of the plant, however, if reserve capacity is allowed for to insure continuity of service, the investment costs for the gas and oil engines will be proportionately higher than for the steam turbine.

From a study of these curves it will be seen that the ratio of cost of steam to gas and oil units is decidedly in favor of the former so that gas and oil power becomes severely handicapped in large work owing to the proportionately greater investment burden. And, unless the price of coal rises materially above the present value, the gas and oil engines will find limited application in stations of any appreciable size, except under very favorable circumstances, where natural gas, by-product gas or some artificial fuel oil can be secured at low prices. If maintenance cost and the additional investment cost required to assure reliability or continuity of service are included, the steam turbine will stand out more prominently.

(b). Hydraulic Turbines.—The redeeming feature of the water turbine, which gives it an advantage over other prime movers, is the absence of fuel. As a result, the operating expenses are practically the same whether the plant is working 10 or 24 hours per day. On the other hand the investment cost is influenced by the load factor, but it is doubtful in any case whether the water turbine and generator will exceed twice that of the steam turbine and generator on the basis of 11 per cent. When the investments costs include an adequate supply of auxiliary capacity to supplement the deficiency in stream flow, the difference between the investment costs of prime movers plus the fuel costs, at any percentage of normal full load rating, will not be so marked, as the investment costs of the units of the hydro-electric plant will not only be much higher than a straight steam plant, but in addition, there will be fuel costs for the reserve units. In fact, with the same class of service, and the reliability charge in the form of duplication of units or steam reserve,

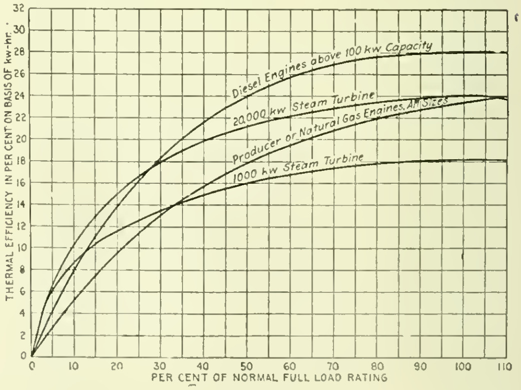


Fig. 19.

the straight steam turbine units will in many cases be more economical.

In low-priced fuel districts the hydraulic turbine is only a competitor of the steam turbine where the development costs are moderate and the load factor reasonably high.

More attention is now being given to the important relation between the efficiency and durability of the water turbine than has been in the past. It is the opinion of some engineers that the most efficient turbine, if operated too constantly at low gate opening is likely to show some pitting

if the head is high, and they recommend that turbines of high specific speed be kept as closely loaded as possible to the point of maximum efficiency, while with turbines of lower specific speed it is not necessary to operate within such close limits.

General.—The proportion of the total investment cost of a 20,000 kw. plant represented by the prime mover and generator for the various types of units, is approximately as follows:

Prime Mover	Total investment cost per kw.	Cost of prime mover and generator per kw.	Percentage of total invest't
Steam turbine	65.00	7.50	15
Gas engine ... ... (Producer gas)	140.00	65.00	46.5
Oil engine	120.00	85.00	71
Hydraulic turbine	125.00	12.00	9.6

The unit costs are the average values obtained from the cost curves given above, while the total costs were estimated and are only approximate, especially in the case of the oil engine, as it is impossible to obtain reliable data for this type of installation.

Considering the different types of prime movers in connection with the total investment cost of the plant it is evident from a study of curves similar to Figs. 16 and 17, developed on a load factor and total cost basis, that with a very poor load factor the all-important point is to keep down the fixed charges, as they are of vastly greater importance than any possible gain in efficiency due to a better type of prime mover of the same class. This is true of any plant, and the curves will show the futility of attempting to carry peak loads by means of water turbines, gas and oil engines or any prime mover that necessitates a large investment per kilowatt.

Efficiency and Heat Consumption—Figs. 18 and 19 are presented to show conservative thermal efficiencies and heat consumptions in B.t.u. per kilowatt-hour at different percentages of normal full-load rating, for two sizes of steam turbines and for all sizes of gas and oil engines, reckoned on the heat in the steam, gas or oil delivered to the throttle valve, and do not include boiler or producer losses or auxiliaries.

An important feature of the steam turbine and especially the oil engine, is that the efficiency does not materially decrease until the load falls below 25 per cent of the normal rating, whereas the gas engine changes rapidly.

In small plants with a low load factor, efficiency may be a secondary matter compared with investment cost, and the cost of maintenance and reliability.

Maintenance and Reliability.—On account of the high mechanical stresses inherent in the gas and oil engines, and heavy reciprocating masses, there is necessarily greater maintenance and repair cost, also a lower reliability of service and a higher class of attendance than for either the steam or water turbine units. The reliability of the gas and oil units has not been sufficiently established to warrant their adoption for reasonably large power stations operating 24 hours daily, without the plant being over-burdened with some type of reserve and consequently excessive investment costs.

Space Economy

This factor affects the investment cost of power and is especially of very great importance for plants of any appreciable size in large cities or where property is expensive. For different sizes of the various types of prime movers the number of kilowatts per square foot of floor space occupied, is from 10 to 15 for horizontal steam turbines, and from 0.5 to 0.8 kilowatt for gas and oil engines. Where a number of gas and oil engines are installed and the passage ways included, the contrast will be still greater.

Summary

Perhaps the most remarkable fact brought out in this report is shown in Fig. 19, where we find that the large steam turbine has now passed the gas engine in thermal efficiency and the only prime mover surpassing it is the Diesel type of oil engine. The oil engine reaches a maximum efficiency of about 28 per cent as compared to about 24 per cent for the latest type of 20,000 kw. high-vacuum steam turbine, and there is every prospect that at least 26 per cent will be realized before the end of the current year.

The present limit in size of the Diesel type engine seems to be about 1,800 kw., so that for plants in excess of 15,000 kw. in capacity the number of units and the space occupied by them becomes excessive. Just what their maintenance under the high cylinder temperature will be is dubious, as there are not sufficient data available to enable the committee to report.

Figs. 16 and 17 summarize the whole prime mover situation in the combined curves of investment and fuel costs, as by taking the sum of the ordinates at any percentage of the rated load it will be seen that the steam turbine is far more economical than any other type of heat engine.

In conclusion the authors wish to acknowledge their indebtedness to Mr. D. W. Mead, a member of this committee, for the curves of Fig. 14 and a portion of the section on hydraulic turbines, and also the kindness of a number of manufacturing companies in furnishing the necessary data.

(Concluded from page 48)

the lines was made for operation at 100,000 volts and the operating voltage was only 20,000 and 40,000 volts, the results were quite different. Since the factor of safety of the insulators was about 10, they were not functioning as lightning arresters or protectors for the apparatus, and consequently every lightning stroke that appeared on the line came with horrible impetus into the station. Switch bushings, transformer bushings, and other insulation that had withstood the conditions of other circuits, immediately began to break down from flash-over or by puncture. Lightning arresters of the best type were then required.

This is a condition that is gradually growing all over the country. Everywhere operators find that insulation on the line is an important factor, and are increasing the factor of safety in the line insulators. Personally, I would never use a factor less than three times normal potential, preferably still higher. The extra investment in insulators is worth while. This ultimately necessary practise will increase the need of lightning arresters.

The lightning arrester in itself is not a surge protector, but an over-potential protector. The gap setting is 25 per cent. above normal operating voltage, and the arrester will operate as a surge protector only after the gap sparks and connects the aluminum cells directly to the line. I am somewhat disappointed that there has not been more adverse criticism, as our foreign friends are finding a great many things to say. I feel that any criticism or any failure of the aluminum arrester to protect the circuit can be explained by some weak local condition, or otherwise, the design of the arrester can be easily modified to meet new conditions. As Dr. Steinmetz has so well emphasized today, the great need at the present time is more definite information. A few years ago it was a very common thing to have bushings fail on transformers and switches, but today, due to the presence of the aluminum lightning arrester, these faults have almost entirely disappeared. Those that have not disappeared I hope to be able to give a reason for, at some not far distant time, as a result of the study of porcelain insulators at high frequencies. Porcelain insulators and bushings have a different strength at 60 cycles on which they are usually tested, from their strength at very high frequencies, such as 200,000 cycles per second—or its equivalent, expressed as steepness of wave front.

Abstract of a Report of the Work of the Meter Committee of the N. E. L. A.

Mr. G. W. Magathaes.

The three principal subjects taken up by the Meter Committee for the past year have been: 1. Maximum Demand Indicators; 2. Standardization of Instrument Shunts; and 3. Legislation Affecting Meters.

1. Maximum Demands

The increasing popularity of demand rates has necessitated the development and production of demand indicators to give the maximum demand on customers' premises for billing purposes.

The first step was to send out to member companies a circular letter having the following questions:—

1. Are you interested at the present time in the development of maximum demand instruments or meters?
2. What general type of instrument would be considered satisfactory?

   (a) Printing watt hour meter, leaving a paper tape record in the form of a reading of the meter at the end of each interval of time, similar to a printometer; or

   (b) Graphic recording watt meter, leaving the record in the form of a continuous curve, similar to a curve drawing instrument or a graphometer; or

   (c) Thermo type of ammeter, leaving the indication in a form similar to the Wright demand meter; or

   (d) An integrating type, showing by means of an indicating hand the highest integrated load used during a definite interval of time, similar to the maxicator; or

   (e) An integrating type, showing by means of an indicating hand the shortest interval during which a definite integrated load is used; or

   (f) A circuit interrupting type, which automatically makes and breaks the circuit when a pre-determined demand is exceeded, usually used in place of a meter, and termed an interrupter or flat rate controller; or

   (g) Suggestions for other types.
3. What time interval do you approve for the various classes of service? Enumerate classes and intervals and reason for each, if possible.

These questions elicited a great variety of answers (440 replies), indicating more than anything else the chaotic condition of the maximum demand question at the present. There were time intervals all the way from one minute to sixty minutes. There were advocates for and against every one of the existing instruments.

While these replies were coming in a general meeting had been arranged between the meter committees of the N. E. L. A. and the Edison Illuminating Association, and representatives of the various meter manufacturers were invited to attend and participate in the general discussion.

A general discussion took place on the question of time interval; the character of the record required, as to whether it should be graphic, or simply indicated.

The general sense of the meeting seemed to be that while the graphic instruments provided a full and complete rcord, there were many classes of service where an indicator, or record of one single demand would be sufficient.

This latter form of instrument was further considered as being available in the form of a separate instrument combined with the watt-hour meter, and further capable of being combined with the watt-hour meters already installed.

The degree of refinement in the record desired was also advanced as a suggestion for a modification of demand instruments, to the end that two or three forms of instruments, varying in cost, be available for different classes of service.

It was felt that certain classes of service required a graphic instrument, which would give a detailed history of the load used; this would be for extra large "off-peak" power consumers. Small customers, either power or light, would require a demand indicator which would give simply an indication of the maximum demand for the month. These instruments need not be very elaborate, and should therefore be of comparatively low cost.

In this class in particular the apparatus should be such that it could be installed in connection with the integrating watt hour meter already in place.

There are also a number of intermediate classes of service, which require more than a simple indication of the maximum demand, but not the refinements which a graphic would supply. An example of such a service would be medium sized power customers, who had an "off-peak" contract,

The manufacturers appreciated the opportunity of a voice in the discussion, and stated that they would welcome any standardization on the question of demands; as in that case they would have something definite to work on, and they were sanguine of early developments of instruments to meet the requirements.

A number of the members of the meter committee undertook on behalf of their own companies to carry on tests on the various demand indicators available at present, connecting them up in series, and running simultaneous tests on the various types. There has hardly been time to obtain complete results on these tests.

A sub-committee, composed of members of each of the meter committees, was appointed to continue the investigation of demand meters, to draw up definitions covering the maximum demands, and also to present a classification of the various kinds of demand instruments at present on the market.

Several of the instruments now available have been turned over to the Electrical Testing Laboratories for investigation as to limits of accuracy.

2. Standardization of Instrument Shunts

This question was taken up together with the committee on electrical apparatus. These two committees sent out to the manufacturers the following letter:—

1. Do you have a uniform drop on all your instruments and meter shunts?
2. If not, what classifications do you use?
3. What is the drop for each classification?
4. Do you use a standard lead and meter terminal construction?
5. Will you please submit dimensioned drawings showing terminal construction?
6. Will you consider changing your practice if to conform to a standard?

As in the case of the demand instruments the two committees notified the manufacturers, and invited them to an open meeting, at which the question of standardization of the drop in shunts and in the terminal construction was discussed.

Thanks to the co-operation og the manufacturers the joint committees were able to make recommendations for two standard milli-volt drops on the shunts for three general classifications of instruments. It appeared to be too drastic a move to make one standard at the present time. The final recommendations by the joint committees follow:—

Classification:—

Class (a) Switchboard type shunts.

Class (b) Portable shunts.

Class (c) Integrating watt hour meter shunts.

The committee recommends:

(1) That each manufacturer adopt a standard milli-volt drop for their shunts of different classifications.

(2) That shunts manufactured for any standard milli-volt drop should be correct within one per cent.

(3) That the standard milli-volt drop should be stamped on both sides of one of the shunt terminals.

(4) That shunts under classification (c), for integrating watt hour meters, should be calibrated within 1 per cent. of the standard milli-volt drop adopted, and that on switchboard type shunts the true milli-volt drop should be stamped on both sides of one of the shunt terminals.

(5) That in view of the variation in present practice the committee adopt at this time standards of 50 and 60 milli-volt, with a recommendation that future committees endeavor to standardize a single value for switchboard shunts.

(6) That shunts under classification (b), for portable instruments, must be interchangeable, and the shunt and instrument as a whole must be within the limits of accuracy prescribed by the Code for electricity meters.

(7) That on portable type shunts the true milli-volt drop should be stamped at a prominent point on the shunt.

(8) That in view of the variation in present practice the committee adopt at this time standards of 100 and 200 milli-volts for portable shunts, with a recommendation that future committees endeavor to standardize a single value for this classification.

(9) That the shunt terminal should be made of such material as to have practically a zero temperature co-efficient, and no thermo-electric effect against copper, wherever possible.

(10) That the ordinary shunt leads should be so designed as to be interchangeable for any specific types of instruments.

(11) That the terminal construction of shunts should provide for the use of ¼-inch bus.

(12) That unless a shunt terminal is slotted, or is of such construction as to prevent movement of the bus, that it should be constructed with two bolt holes in each terminal in capacities of 500 amperes and up.

3. Public Utility Regulation

This embraces all legislation and regulation affecting meters.

*Out of the nine provinces of Canada five have Public Service Commissions. Out of the 48 States 46 have Railway or Public Service Commissions, and nine have Commissions adopting or proposing standardization for electrical service.

During the past year there have come to the notice of the committee five new commissions, eleven commissions adopting new rules, and one case of state laws and municipal ordnances.

In some of these cases, where the meter committee have been notified, they have placed themselves at the service of the member companies affected by the proposed legislation or rulings; and together with the executives of the N. E. L. A., have taken up with the various commissions the question of the proposed legislation, and have been instrumental in moulding these rules.

They have been met, in all cases, with a cordial reception on the part of the commissions, who have welcomed the expert knowledge that could thus be brought to bear on the formation of new rulings.

*Mr. Ormond Higman (head of the Government Meter Testing Bureau), stated in this connection that if the several provinces did have Public Service Commissions, nevertheless, meters came under the jurisdiction of only one body, namely the Bureau of Weights and Measures.

Canada and the United States were divided up among the various members of the committee; each member being detailed to get in touch with the various provincial or state associations, and keep a look out for all proposed rulings or legislation.

In some of the states the state associations have meter committees, and the purpose of the N. E. L. A. meter committee member was, if possible, to become a member of these sectional meter committees.

An instance of the co-operation between the commissions and the meter committee arose when the Wisconsin Railroad Commissions were establishing new rules and regulations covering electrical service. Rule No. 28 covered the question of demand instruments, and required impracticable limits of accuracy. This was brought to their attention, and they laid that rule on the table, stating to the N. E. L. A. that this rule had been suspended for one year or until an investigation and report by the various utilities committees had been made; it being the opinion of the commission engineers that the matter could be adjusted within the year, or if not, further suspension could be requested.

Another matter which has been receiving the attention of the committee is that of ampere hour meters. The question has arisen of using the less expensive ampere hour meter instead of the watt hour meter, on d.c. systems where the voltage is practically constant.

A number of the members of the meter committee, on behalf of their companies, undertook to carry on tests on ampere hour meters in service.

These meters are installed in series with the ordinary watthour meters, and also with recording volt meters, so as to have a record of voltage fluctuations; these tests are to extend over a year, in order to give the ampere hour meter an exhaustive test under service conditions. There are, therefore, no results as yet from this work.

The committee also completed the work on standardization of instrument and meter diagrams, and has given some consideration and space to the accuracy of meters, to breakdown tests on induction meters, and to some additional data of the meterman's handbook.

The Work of the Street Lighting Committee of the N. E. L. A.

Mr. Wills Maclachlan

The President and Managing Committee have asked me to bring to your notice in a short way some of the advantages that accrue to the Canadian Electrical Association, due to the privilege of the Canadian Electrical Association having a member on each standing committee of the National Electric Light Association. To do this I will outline the work of the Street Lighting Committee of the National Electric Light Association.

The question of street lighting has been taken up by committees of the National Electric Light Association since 1894, but it has been only within the last few years that it has been possible to expend a great deal of time and money on investigating the problems of street lighting due to the fact that other, possibly more important problems, were being investigated and were taking up all the time that was available.

Within the last few years valuable data has been collected, and the Street Lighting Committee has been trying to present to the National Electric Light Association information that would be of value to the engineers and managers of central stations in investigating their own street lighting problems. The committee of 1894 made a report and suggested that the arc lamps that consumed 450 watts should be rated as a 2,000 candle-power lamp. The committee of 1907 suggested that arc lamps on a spacing of from 200 to 600 feet should be rated at the intensity of direct illumination as measured 200 to 300 feet away from the lamp on a level street. The committees of 1911 and 1912 spent most of their time in investigating and collecting statistics with

regard to ornamental street lighting, advertising value of street lighting, etc. The 1913 committee went into the question of certain clauses in street lighting contracts, and made certain suggestions with regard to the important clauses in these contracts, and also presented the decisions from certain Public Service Commissions.

Taking the above into consideration, the committee that reported at the 1914 Convention in Philedelphia thought that the time was ripe to go into fuller investigations with regard to street lighting problems, as this question was becoming of a very important nature, due to the fact that traffic speeds were greater, and the congestion of traffic in large cities was becoming very serious, and also due to the fact that the public in general was becoming educated to a point where it demanded higher standards of illumination than were used in the past.

At the initial meeting of the 1914 Committee plans were prepared to carry on certain experimental work in street lighting, and four objects were set forth to obtain definite information upon:

1st.—Physical side of street lighting.
2nd.—Psychological side of street lighting.
3rd.—The economics of street lighting.
4th.—The ideal street lighting contract.

First taking up the physical side of street lighting. It was arranged to have two streets that converged at an angle equipped for about one-half a mile each with experimental systems of street lighting, one street to be equipped with small incandescent lamps mounted near the curbs. It was also arranged to have large incandescent lamps placed at regular intervals, but on a longer spacing than the small incandescent lamps. The other street is to be arranged so that it can be equipped with any type of illuminant that is on the market at the present time, and so that the spacing, height, etc., can be varied throughout the experiments, the object of the physical experiments being first, to obtain as ideal an illumination on the first mentioned street as possible and then use it as a comparison for comparing the other street as the illuminants were changed and as height and spacing was effected. After the tests were made it was the intention to take photometric readings and photographs in both streets after each experiment, and also it was arranged that the distribution curve of the different lamps used should be taken by ordinary laboratory methods.

At the very outset of the Committee's work, it was recognized that illumination has another phase besides the physical one, viz., the psychological. It was recognized that illumination must be judged from the effect that it has upon persons that are subjected to it, and the Committee, after investigating the good work, that was being done by applied psychologists in investigating the degree of fatigue and other mental processes in connection with telephone operators, motormen, etc., decided that it would be well to have the assistance of a psychologist in arranging a series of tests that were to be applied to observers in connection with the investigation. Professor Hugo Munsterberg, Professor of Psychology in Harvard University, was invited to confer with the Committee in this regard, and after meeting the Professor and having some of the phases of psychology with regard to illumination explained, the Committee felt that it had opened up a new side to illumination, and that any report that it should make that neglected the psychology of the situation would be entirely iinadequate. Professor Munsterberg explained that investigation of illumination by psychologists was practically speaking an unknown field, and that he would have to consider the matter very seriously before suggesting tests, but he agreed to think the matter over, and make certain suggestions to the Committee. It was afterwards arranged that a young psychologist under the direction of Professor Munsterberg should have an active part in the carrying on of the tests, these tests to be applied to private citizens, policemen, chauffers, and illumination experts.

At this point of the Committee's investigation it was thought advisable to obtain the advice and help of other bodies, who were deeply interested in the question of street lighting, and the Joint Street Lighting Committee was formed to consist of the Street Lighting Committee of the National Electric Light Association, the Street Lighting Committee of the Association of Edison Illuminating Companies and an advisory committee to be formed of illumination experts. At a general meeting of this committee it was recognized that any report on the question of street lighting would be very incomplete unless the question of economics was recognized and it was arranged that at the same time as the tests were being made that a Sub-Committee would be formed to carry on the work of obtaining data with regard to costs of construction, costs of maintenance, repairs and overhead expenses in connection with the different types of street lighting that were being investigated.

After looking over the work that was before the Committee it was thought that the data obtained would be very useful to any central station. The central station would have results of the physical tests of the illuminants, the results of the psychological tests of the illuminants and the economics of the situation, but it was felt that to round the situation out and to make it complete, that some definite suggestions with regard to the clauses of a street lighting contract should be incorporated. Mr. Mortimer, the President of the North American Company, was approached on this subject, and as he had recently some considerable experience in drawing up street lighting contracts, he was asked to be the Chairman of a Sub-Committee that would draw up a standard form of contract. This Committee was then formed, and they have made very satisfactory progress in the work that they have in hand.

Thoroughness of the Work

The above will give in a short way an idea of the thoroughness with which the Committees of the N. E. L. A. go into any matter that they take up, and it is the privilege of the Canadian Electrical Association to appoint one member on each of the standing committees of the N. E. L. A. It was my privilege during the past year to represent you on the Street Lighting, and it is certainly a distinct advantage for any man to work on the Committee with such men as constitute the N. E. L. A. Committee. These men represent the most up-to-date forms of practice in central station work.

The standing committees of the N. E. L. A. are from year to year bringing out reports that might be considered as classics in regard to central station practice. I need not mention the reports of the Meter Committee, the reports of the Overhead Lines Committee and the reports of the Publication Committee of the Commercial Section, and after next year we hope that the Street Lighting Committee will have marked a milestone in the advance of illuminating engineering in connection with street lighting. The advantage to the company and to the officers of the company that are represented on these committees, as shown above, may well be realized, but the real benefit will eventually come to the public, who will receive better service than they have received in the past, and although I realize that the question of rates is a very important one, yet I think that the public is realizing that service and continuity of service is the big question in the supply of electricity, and the company that gains the benefit of the consensus of opinion of the foremost men in the industry, and who has its officials in close touch with these men by being on the committees of the National Electric Light Association, will be able to give to the public better service in every branch of central station work, and will become a real public service corporation, having for its motto an adaptation of the motto of the Prince of Wales "Ich dien" making it "We serve."

Electric Railways

Cost of Installing Bonds

In the choice of bonds too much stress is sometimes laid on the first cost, as when it comes to installation and maintenance certain types are much more to be desired than others. Quite often the added expenditure incurred in these two factors more than offsets the difference in first cost. The Electric Railway Journal prints some interesting figures submitted by Mr. C. H. Fuller, Engineer of Maintenance and Way of the Macon Railway & Light Company. This writer does not favor very short and rigid forms of bond, as in most cases the track where not laid in the concrete base of paving is subject to considerable vibration of the joint resulting in the mechanical destruction of the bond. On the road mentioned three types of bond have been adopted as best meeting the requirements, namely (a) a concealed, stranded, compressed terminal type used under the splice plates, 7-in. to 9-in. in length, depending on the bolt spacing; (b) a stranded long bond, 24 to 36 in. in length, with compressed terminals, to be used around the plates, and (c) a pin-compressed terminal bond of about the same description as (b) to be used where rail is too small to admit of good work with the compress or for single replacements to be made by the track crew when it is not convenient to send for the bond crew. This company have been using these types of bond during the last two years and the writer states that no single case of failure due to mechanical conditions has been brought to his attention. In the cost figures which follow a crew usually consists of one man to run the drill (a Duntley electric track drill) and a helper who assisted in moving the drill and pressed in the bond. Both men removed and bolted up the plates as occasion required. The wage of the drill runner was $1.50 and of the helper $1.35 per day of ten hours.

Case 1. Paving job. Track laid and surfaced, with two bolts in each splice. Bond crew removed the plates, drilled two holes, applied the concealed bond with a screw press and full-bolted the joint: 174 bonds at $0.2625 per bond.

Case 2. Installation of a crossover in Belgian block paving. Bond crew drilled the holes, applied the concealed or long bond as required, full-bolted the joints: thirty-five bonds at $0.266 per bond.

Case 3. Repaving job. Old plates and bonds were not disturbed. Twenty-eight inch bonds with compressed terminals were placed around the old plates. Bonding crew had a good chance to do record work and placed 128 bonds at $0.175 per bond.

Case 4. Paving job. Bond crew removed two bolts and plates, drilled for and placed concealed bond, replaced the plates with two bolts loose for track gang to finish; 199 bonds at $0.1825 per bond.

Case 5. Paving job. Bonding crew applied concealed bonds while track gang was laying track, but made no special effort to full-bolt the joints: eighty-five bonds at $0.168 per bond.

Case 6. Paving Job. Track all surfaced, double track, bond crew following all four rails as they came to the joints, rails 60 ft. long, special effort to get low bonding costs, track gang applying the splice plates: 269 bonds at $0.09 per joint. This was an exceptional case and the same crew has never been able to break its own record.

Case 7. Laying track in dirt roads. Bond crew applied pin-compressed terminal bonds under the plates, doing the bolting up: 113 bonds at $0.136 per bond.

Case 8. Paving job. Remove plates with two bolts, drill two holes, compress bond and replace plates with four bolts, continuous work: 187 bonds at $0.235 per bond.

Case 9. Paving job. Remove plates, drill holes with hand drill, compress bond, replace the plates: eighty-three bonds at $0.375 per bond.

Case 10. Track laid in dirt road and fully surfaced. Remove plates with four bolts, drill holes and compress bond, replacing the plates. The four men in the crew worked continuously: 1020 bonds at $0.2405 per bond.

Case 11. Remove plates having four bolts, drill and press in bond, replacing plates: fifty-four bonds at $0.292 per bond.

The following is a six months' record of bond replacements, the work being scattered into installations of a few bonds here and there. In all cases the cost includes the breaking out of old bolts, removing old plates and old bonds, reaming or drilling new holes and rebolting plates and the time lost moving about. The work usually was done in the intervals between construction jobs and other labor.

First month	85 bonds at	$0.285
Second month	42 bonds at	0.31
Third month	54 bonds at	0.295
Fourth month	37 bonds at	0.35
Fifth month	94 bonds at	0.325
Sixth month	21 bonds at	0.36
Total	335 bonds at	*0.313

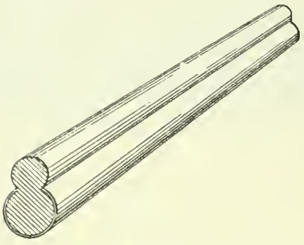
*Average cost per bond.

Low Resistance Conductor

Mr. Louis Steinberger, president of the Electrose Manufacturing Company, has just secured a patent on what is termed a flexible electric conductor which is adapted for general use, but more particularly to conductors for trolley and catenary overhead line construction for purposes of electric traction. The body of the wire is made of two portions (in outline like the figure eight) integral with each other and each having a nearly cylindrical form, one portion being of greater diameter, however, than the other. This body portion is preferably made of steel or tough iron and has great tensile strength. To the larger portion of this wire a ribbon of copper is applied as shown in the illustration. This is accomplished by pressing up the edges of the copper ribbon so that they are closed firmly into the channels in the body of the wire at the junction between the upper and lower portions.

It is claimed that the ohmic resistance of this flexible electric conductor is very small; this is particularly the case if the parts be of large size. The conductor is suitable for

either d.c. or a.c. currents, but for the latter it has a peculiar advantage owing to the fact that the copper ribbon is so disposed as to take advantage of the so-called "skin effect" which follows from the well-known fact that a.c. currents of high frequency follow the outside rather than the inside of a

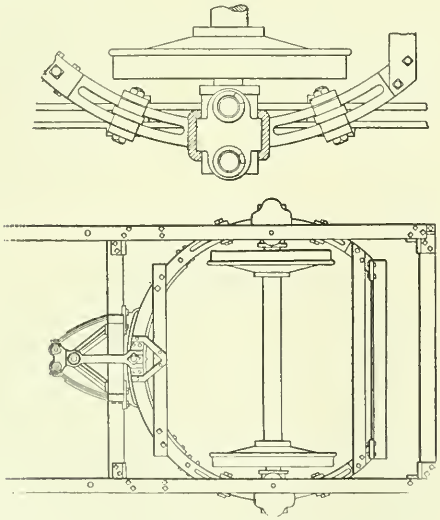


New trolley wire.

conductor body. It follows that if the outside conductor be of copper or other low resistance material the conductivity of the whole is greatly increased.

Radial Axle Single Truck Cars

Mr. Fred Steffens, master mechanic of the St. Josephs Railway, Light, Heat & Power Company describes in the Electric Railway Journal a patent he has recently secured on a radial axle long wheel base truck, the construction of which is illustrated in part in the accompanying diagrams. Interest in radial axle single truck cars has been revived by the recent purchase for the Third Avenue Railway System of New York of a total of fifty single truck cars with radial axle trucks. These operate with perfect satisfaction on a 35-foot car body, a size which is ample for most companies operating in towns or suburban city districts. The following



Section of one end of radial axle truck.—Upper figure shows detail of roller mechanism at journal box.

paragraphs are taken from Mr. Steffens' description of his new patent.

This truck made its first trial trip on April 30, when it was taken over all the worst tracks and curves in St. Joseph. Although the truck was new and rigid it did not refuse to go over any of our tracks. It entered regular service under car No. 12 on May 1 and has been in service ever since. The truck frame is 22 ft. 5 in. long over all. The wheelbase is 15 ft., which the writer believes is the longest ever built to run under a car successfully. This wheelbase was used because the car would not take a longer truck; otherwise the writer would have built the truck with a 16-ft. or 18-ft. wheelbase, as his design is adapted for lengths as great as 25 ft.

Car No. 12 is 22 ft. 8 in. over the corner posts, and 36 ft. 9 in. over the bumpers. Previously it was mounted on an 8-ft. wheelbase Dupont truck, where the overhang and the oscillation were so great and the swing was so heavy when it entered a curve that very unsatisfactory service followed. The use of a radial axle truck makes it ride as steadily as a double-truck car.

This truck is equipped with a curved horizontal frame which nearly encircles each axle, as shown in the drawings. At the intersection of this curved frame and the normal position of the axle, the frame carries an inverted "U" member which can slide vertically outside and above the adjacent journal box. On each side of the journal box the curved frame is provided with concave runways on which rollers are mounted. Normally these rollers rest in the lowest portions of the runways, but when the trucks turn a curve they run up the runway for a distance proportional to the degree of curvature. Gravity tends to return the rollers to the lowest positions when the trucks return to straight track.

However, to assure the prompt return of the axles to their proper position each truck has a supplemental spring-actuated mechanism of the character shown in the plan view. It will be seen that the middle point of the circular frame carries a lever which is pivoted on a vertical pin. At the other end of this lever are two mounted friction rollers against which two leaf springs bear. These springs are secured to an angle bar and press toward each other, thereby resisting the movement of the lever from the central position. After the car wheels have turned a curve and are on a straight track the springs assist the hanger rollers to return the axle and car wheels to their proper position. In going up or down grades the leaf springs insure the proper positioning of the axle relative to the frame in case the runway rollers alone do not effect this function.

While in this particular truck the car body supporting frame connects the two pairs of wheels, it will be readily seen that each pair of wheels is in a frame by themselves. They could be separated by leaving out the centre top and bottom plates, and continue to work just as well if not better in case a wheelbase longer than 14 feet is used. The radial truck should supersede all other single or double trucks for two-motor equipments, for since it permits the weight of the motors to be carried on two axles instead of four it gives better propelling power and therefore less skidding, spinning and energy consumption.

The Edmonton Interurban Railway Company will resume operations, with an hourly service, between Edmonton and St. Albert on the first of October. They are at present electrifying the road under the supervision of Mr. W. T. Woodroofe, formerly superintendent of the Edmonton Municipal Railway System. It is undertsood also that negotiations are being carried on between the company and the Edmonton municipality whereby the latter will supply electric energy for the operation of the road. It is stated that the company will erect a car barn and work shops at St. Albert.

September 21st has been set as the date on which municipalities will vote on the question of closing contracts with the Hydro-electric Power Commission of Ontario to build an electric road through the Newmarket, Port Perry and Uxbridge district.

The Dealer and Contractor

Code of Ethics

The National Electrical Contractors Association at their recent convention adopted a code of ethics for the general guidance of the members of the association. In presenting this code it was pointed out by the committee who had the matter in charge that a code of ethics according to their understanding was simply a declaration and not a set of laws which could be incorporated in the constitution or by-laws. Law does not inculcate in men the principles of honesty and fair dealing and this code, it is pointed out, was not intended to be construed as applying to men who have not an inborn tendency toward the Golden Rule. The committee, in the preparation of this code, have adopted the position that members seek to join or retain their membership in any organization because of their desire for mutual helpfulness. The code of ethics reproduced below indicates that the members of the National Electrical Contractors' Association consider themselves a profession rather than a class. The principles defined herein would do justice to their country's oldest and most honorable organizations.

Section 1. Members of the Association shall regard themselves as being engaged in a business in which there is a well defined duty and obligation towards the public and themselves. The business demands that members use every honorable means to uphold the dignity and honor of this vocation, to exalt its standards and to extend its spirit of usefulness.

Section 2. Every member of this Association should be mindful of the public welfare and should participate in those movements for public betterment in which his special training and experience qualify him to act. He should not even under his client's instruction, engage in or encourage any practices contrary to the Rules and Regulations Safeguarding Life and Property, for as he is not obliged to accept a given piece of work, he cannot, by urging that he has followed his client's instruction, escape the condemnation attaching to his act. Every member of this Association should support all public officials and others who have charge of enforcing safe regulations in the rightful performance of their duty. He should carefully comply with all the laws and regulations touching his vocation, and if any such appear to him unwise or unfair, he should endeavor to have them altered.

Section 3. It is unprofessional for a member of this Association to assist unqualified persons to evade or to lend himself in the evasion of any of the recognized rules and regulations governing electrical work.

Section 4. Members of this Association should expose, without fear or favor, corrupt or dishonest conduct and practices of the members of their business, and it is their duty to bring to the attention of the proper authorities the existence of electrical conditions which are unsafe to life and property.

Section 5. Members of this Association owe a duty to the business of refusing to furnish estimates to general contractors who do not regard bids as final and binding upon which they are awarded general contracts.

Section 6. Members if this Association shall not falsely or maliciously injure, directly or indirectly, the business reputation, prospects or business of a fellow member of this Association.

Section 7. Members of this Association shall not attempt to supplant a fellow member after definite steps have been taken toward his employment or toward the letting of a contract to him. Nor should they offer any interference in the carrying out of said contract or commission to the end that loss or damage may result to the fellow member.

Section 8. Whenever disputes or differences arise between members, it should be the duty of the party to the controversy to submit the trouble to an arbitration of two disinterested members of this Association and in the event of a failure to arrive at a satisfactory settlement, then upon request, the President of the National Association shall appoint a third member of the Commission and the decision of the majority of said Commission shall be final and binding.

Horn-gap Arresters

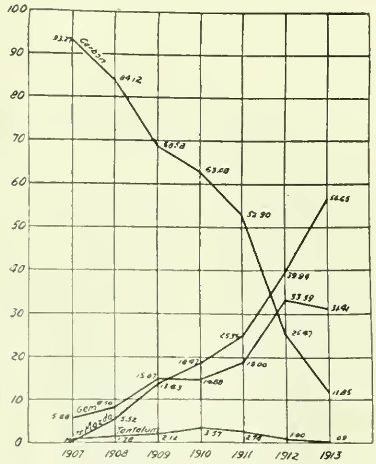
To meet the demand for a lightning arrester embodying all the characteristics of the Burke series horn-gap arrester, but with a resistance in the ground circuit of each phase, the Railway and Industrial Engineering Company, Pittsburgh, have placed on the market the protective equipment illustrated.

The arrester consists principally of a triangular choke coil wound with strap copper and a ground horn mounted on a special post type insulator, which supports and insulates from each other and the ground the resistance units. In the design of the arrester, the two factors which

cause a surge to arc the ground are concentrated at one point. That is, an efficient obstruction in the form of the triangular choke coil, and a point of weak resistance to ground in the form of the horn gap. A surge meets its first obstruction at the first sharp turn of the choke coil, opposite which point is mounted the ground horn. Due to this construction the gap to ground may be set fifty per cent. greater than the ordinary shunted horn gap and the same protection be obtained. The resistance is of such ohmic value as to limit the flow of dynamic current to approximately ten amperes, should two or more phases discharge simultaneously. It is inserted in the ground circuit of each phase, and is composed of koppat. This resistance material is extremely strong mechanically and possesses electrical characteristics which make it particularly adaptable to this service. It has a very low positive temperature coefficient to resistance, conducts current uniformly throughout its entire mass, and is not affected by high frequency discharges, as are many other composition resistances. These resistance columns are so constructed that they may be used in connection with Burke arresters now in service, operating with horns connected direct to ground.

Incandescent Lamp Manufacture

An interesting set of curves showing the number of incandescent lamps of each type, in percentage, manufactured during the past seven years is published by Mr. G. F. Morrison, manager of the Edison Lamp Works of the G. E. Company in the last issue of the General Electric Review. Mr. Morrison states that the number of domestic incandescent lamps, exclusive of miniature lamps, sold during 1913 was slightly in excess of 100,000,000, an increase of 59 per cent in seven years. The curves show that during this period the tantalum lamp has practically gone out of existence having represented in 1910 some 3½ per cent of the total number of sales. During the same period the carbon lamp which in 1907 represented nearly 94 per cent of the total of

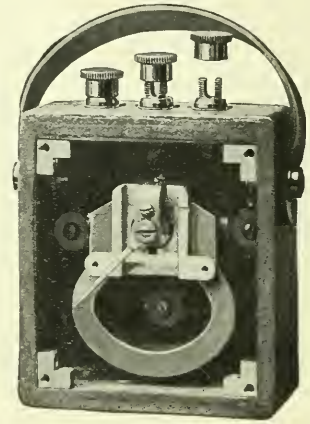


incandescent lamps in use now represents only a little over 11 per cent. On the other hand the Gem and the Mazda types have increased in popularity from 5 per cent. and 1 per cent respectively to 31 per cent and 56 per cent. During 1913 the increase of the Mazda lamp business was approximately 60 per cent, the total sales of this type exceeding that of all other lamps combined. It is further noted that the 25 watt lamp embraces 29 per cent of the total Mazda lamp business, the 40 watt 27 per cent and the 60 watt 15 per cent. In street series lamps the 60 candle-power is the most popular.

Referring to the importance of carefully selecting lamps of proper voltage Mr. Morrison states that the ability of the manufacturer to turn out lamps accurately to a predetermined voltage and efficiency makes the introduction of lamps of the proper size and correct voltage on the lines on which they are to be operated especially necessary. There is no economy, but on the other hand there is an actual loss to the consumer and to the central station in operating lamps at a voltage below that for which they are manufactured. The total cost of a given amount of light is greater at any efficiency poorer than that of the manufacturer's rating.

New Direct-Current Portable Meters

A new line of 5 inch diameter direct-current portable ammeters, voltmeters and millivolt meters, known as the type PW, has just been placed on the market by the Westinghouse Company. These instruments are direct reading



and suitable for battery testing, signal work, and all purposes where an instrument of pocket size is desirable. They are particularly adapted to testing electric lighting and starting equipments of automobiles. They operate on the D'Arsonval principle, having a moving coil and a permanent magnet, which renders them free from residual errors. The complete movement is mounted as a unit. A unique feature is the arrangement of the moving element which can be readily removed by taking off the cover and removing the two screws on the side pole-piece support. The entire moving element and the bearings can then be lifted out as a unit and can be replaced in exact position. This makes repairing possible without disturbing the alignment of the magnetic circuit.

A Large Contract

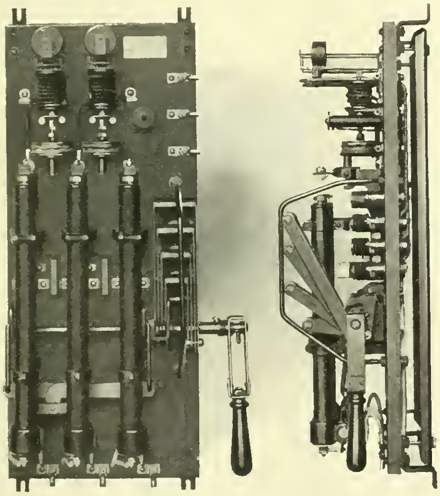
A large contract has recently been placed with the Northern Electric Company for the supply and installation of all the necessary cable and cable accessories in connection with the Cedars Rapids Manufacturing & Power Company's new plant at Cedars, Que. The order calls for approximately 220,000 feet of cable, divided up into 90,000 feet of paper insulated, lead sheathed, 124,000 feet of rubber covered, 3,000 feet of varnished cambric and 3,000 feet of bare stranded conductor.

The paper insulated cables are made with single, triple and quadruple conductor cores varying in size from No. 6

B. & S. to 1,250,000 c.m. and in voltage from 660 to 13,200, the largest part of this item being 54,000 feet of 300,000 c.m. 3-core, 13,200 volt cable running between their generating station and transformer building. The rubber covered cables vary in size from No. 10 B. & S. to No. 4/0 B. & S. and in voltage from 660 to 4,400, the larger part of this item being 86,000 feet of multi-core remote control cables made with two to eight conductor cores. The small item of varnished cambric and bare stranded conductor will be used in making miscellaneous connections in the power house. Over two hundred potheads of different sizes and types will be used in protecting and terminating the ends of the paper power cables.

Carbon Compression Type Resistance Starters

The Allen-Bradley Type H resistance starters illustrated herewith, made in sizes up to 100 horse-power, provide for no-voltage and overload protection for induction motors. They are claimed to be the result of a careful study of the requirements of the apparatus for this service, in while the design has been further benefitted by experience gained in the manufacture of previous alternating current devices, each of which contained some, but not all of the features incorporated in the present machine. The starters embody the carbon compression resistance units, which during many years of service are claimed to have demonstrated their superior efficiency over other forms of resistance. The



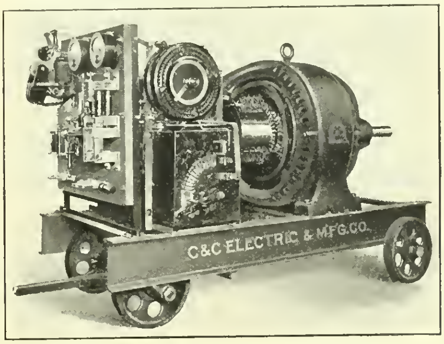
wire wound or grid type resister at times causes considerable trouble and exasperating delays, due to the fact that it becomes corroded and eventually burns out, which is not possible with the carbon compression resistance. The latter also gives the motor a more even and smooth start, as the resistance is not cut out spasmodically but is changed gradually with the increase of pressure applied to the resistance column. One of these units is supplied for each individual phase. The pressure applied to the tubes at any instant is the same, which is brought about by an equalizing mechanism, so that the phases are always entirely balanced.

Have Opened Lighting Division

The H. W. Johns-Manville Company announce that owing to the rapid growth of their lighting fixture business they have established a new division of their eelctrical department to be known as the Lighting Division. This new division will enable the company to enlarge the scope of their business and service in lighting fixtures by the addition of many new lines. The new division will be prepared to furnish, from stock, designs in brackets, pendants, hangers, ceiling fixtures, glassware, etc., to meet practically every requirement. The company will also be equipped to undertake special fixture work.

Portable Arc Welder

A new portable arc welder, having all the features of the larger stationary equipments has been designed by the C. & C. Electric & Manufacturing Company, of Garwood, N.J. The equipment is extremely flexible for welding and repair work in ship yards, machine shops, locomotive shops and foundries. The motor circuit can be connected to any available part of the shop or yard circuit. The apparatus, consisting of dynamotor, control apparatus and switchboard are supported on a base of I-beams and mounted on a heavy iron truck on wheels. The welding current is generated by a 110 volt dynamotor, the generator end having a capacity of 200 amperes at 70 volts. The motor shaft is extended



for receiving a pulley for belt drive by gas, oil or steam engine when in use on barges, shop yards or where current is not available.

As illustrated, the starting box and field control rheostat are mounted on the frame structure supporting the switchboard. The switchboard carries main line switch and circuit breaker for the motor, and automatic control relays for two individual welding circuits. A set of four hundred amperes will provide for one graphite electrode or two metallic electrodes for welding. The graphite electrode gives a temperature of about 4000 deg. C. and is used for cutting, pre-heating and welding with auxiliary bar. The metallic electrode for welding furnishes the welding metal directly and can be used on vertical or overhead work. The automatic relays in each welding circuit, insert and cut out small steadying resistances on drawing the arc and thereby prevent burning of the metal. Automatic devices also prevent interference between operators. An ammeter in the welding circuits permits the accurate adjustment of the current to the work.

Trade Inquiry

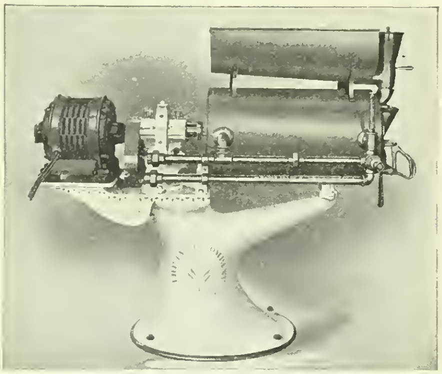
Name and address of Inquirer may be obtained on application to the Electrical News.

751. **Electric machinery.**—Canadian manufacturers are invited to correspond with Havana commission merchant.

The Canadian Westinghouse Company have opened an office in Edmonton, Alta., at No. 50 McDougall Avenue. Mr. G. D. Powis is the company's representative.

An Individual Motor-Driven Ice Cream Freezer

The individual motor-driven ice cream freezer is now generally recognized as the most economical and sanitary type. By doing away with all belts and countershafts on a battery of freezers, a great deal of power is saved that would otherwise be used in turning idle shafting, and much greater cleanliness and safety is secured. The freezer illustrated is made by the Tyson Company, Canton, Ohio, and represents a most modern type. The freezing is effected by brine which flows around the freezing cylinder and is circulated by means of a small pump. Extensive tests show that a given quantity of ice can produce a greater freezing



effect when used as brine than when employed as ice in the tub type freezer. All parts touched by the cream are of non-corrosive metal and can be easily cleaned. The rear end is insulated by a dead air space. In front, a device is employed to show the consistency and "expansion" of the cream; a small quantity constantly flows out of the freezer into the half-funnel, plainly seen on the illustration, and back into the freezer. The operator, therefore, knows the conditions of his mix at any moment and can stop the freezing at the proper time, thus obtaining uniformity and preventing waste of brine by over freezing. The freezer shown has a capacity of 40 quarts and can freeze 500 gallons a day. It is driven by a Westinghouse Electric 2 horsepower alternating current motor.

Fire alarm installation in Pembroke

The town of Pembroke can now boast one of the most up-to-date fire alarm installations in Canada. The equipment consists of the following:—

1—2 storage battery switchboard.

1—storage battery rack 60-in. double, white wood.

50—cells, BT storage battery.

1—motor-generator set, 110 volt, 60 cycle, direct to ¾ kw., d.c. generator.

1—12-in. Excelsior gong.

1—Tower bell striker No. 5, not including bell.

1—6-in. Turtle gong in firemen's house.

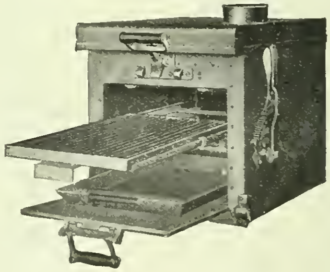
22—plain Excelsior fire alarm boxes.

In addition, orders for eight private boxes were received from the following:—Pembroke Lumber Company, 2; Colonial Lumber Company, 2; Shook Mills, Pembroke, 1; Steel Equipment Company, 1; C. P. R., 1; Lee Mfg. Company, 1; and the corporation later purchased a 12-in. gong and indicator combined and two 6-in. electro-mechanical gongs.

It is encouraging to note that this town did not attempt to cut down the initial expense by installing a gravity battery system. It is generally recognized that while a gravity battery system is somewhat cheaper to install than a storage battery system is, the annual up-keep of the gravity battery system compared with the storage battery equipment will eat whatever money is saved on the initial installation within four or five years. Many of the small town systems which have been installed in Canada previously have used gravity batteries and later on found that it was more economical for them to use storage batteries. This, of course, meant a big additional expense not only in the cost of operating the gravity type of battery, but further in the necessary expense incurred by changing the type of battery. Equipment for this installation was supplied by the Northern Electric Company.

Hotel Radiant Broiler

Just as electricity is used more and more every day in almost every industry, so it is becoming more popular in the hotel. It means efficiency in the kitchen, because it is quicker, cleaner, safer and more convenient. The C. G. E. hotel type broiler shown herewith has about 280 inches of broiler surface—a capacity of about 70 lbs. of meat per hour. The quality and uniformity of the broiled meat are unsurpassed by any other method of broiling. The Radiant heating unit, located at the top of the broiler, is easily and simply controlled. The grid on which the meat rests is supported on a movable frame, which can be raised or lowered at will. The gridiron can also be drawn out for turning or removing the meat. A removable drip pan rests on the bottom of the broiler chamber.



Consisting of sheet metal and angle iron—all walls thoroughly heat insulated—it should last a life-time. The heating unit is divided into two windings; the main winding consuming about 4,500 watts only when actually broiling and the auxiliary winding consuming 500 watts and used for keeping the broiler hot between broiler operations. Considering the speed and uniformity of the broiling, the operating cost is claimed to be very reasonable.

The next meeting of the Electrical Supply Jobbers' Association of America will be held at the Clifton Hotel, Niagara Falls, Ont., September 9, 10 and 11.

The Naugle Pole & Tie Company announce that they have opened an eastern office at 21 South High Street, Columbus, Ohio. The new office is in charge of Mr. L. E. Morier, who has been with the company in different capacities for the past nine years.

The Canadian Westinghouse Company have opened an office in the Telfer Building, 203 Hardisty Street, Fort William, Ont., so as to better take care of their increasing business in the northwestern portion of the province. Mr. B. James will have charge of the Fort William office.

Another Needless Fire

It is said that the fire which recently destroyed some forty-eight cottages in Grimsby Beach, Ont., was caused by the use, in one of them, of a small coal oil stove, for ironing purposes. In these days when "Safety First" and "Conservation" play such a prominent part in our daily life the use of eighteenth century methods by one individual should not be allowed to jeopardize the lives and property of forty-seven. Electric current and equipment for ironing are available in Grimsby, both at reasonable cost. Were the cost many times as great it would have been less expensive in this instance than the coal oil stove.

Reverse Current Relay

The Condit Electrical Manufacturing Company of Boston have developed a reverse current relay designed for transformer protection in installations where transformer banks are operated in parallel. These relays are designed for service where it is desired to open the alternating current circuits when the direction of current flow is reversed. A circuit breaker with shunt trip coils is required, the relay making connection to the trip coil to open the breaker, the specific purpose being to instantly cut out that particular bank of transformers wherein a fault may occur, without the interruption or discontinuity of the remainder of the system. The relay will operate equally well on all transformer connections; that is to say, on delta-delta or star-star, or delta-star, as the case may be. The relay consists of two powerful electromagnets which either close or maintain the tripping circuit open. Upon a reversal of current the relay is adjusted to operate and permit the tripping circuit to be

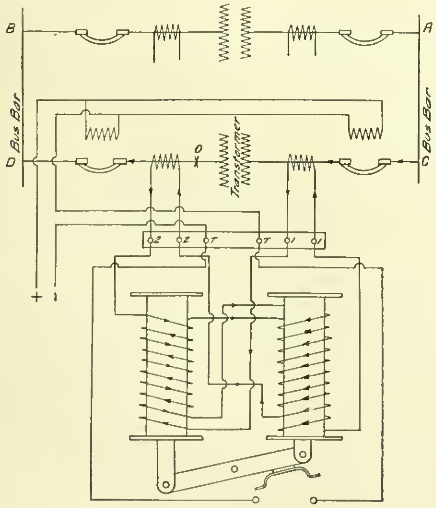


Fig. 1.

closed, resulting in a simultaneous opening of the circuit breakers on both the primary as well as the secondary sides of the transformer bank.

Fig. 1, the wiring diagram, illustrates the electric circuits of the relay, and, as indicated, instead of tripping the breakers mechanically, it closes a contact which allows current to pass through the shunt trip coils of the breakers, thus permitting them to open. Its operation is independent of overloads or short circuits, current transformer characteristics, potential, direction of energy flow and only operates when there is a relative reversal of current in primary and secondary of the power transformers. The action of the relay is as follows: Assume the direction of the flow current to be as indicated by the arrows in Fig. 1. Under normal load conditions, the flow of current from C to D has no effect upon the relay except to keep the contacts of the shunt trip circuit open. However, should a fault occur, say, at the point O, the tendency would be for the current to now flow in the direction A, B, D, O, causing a reversal of current in a section of the feeder, D, O. This likewise produces a reversal of current in the current transformer and

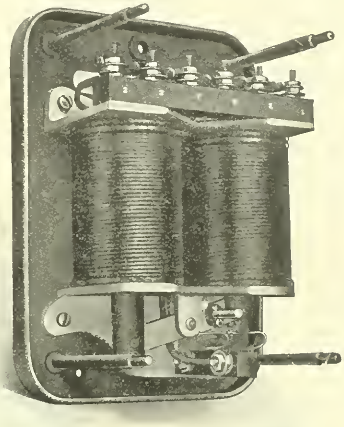


Fig. 2. Internal View.

causes the relay to operate and close the shunt trip coils of the circuit breakers. The circuit breakers both opening simultaneously, completely isolate the faulty bank of transformers, and the continuity of the entire system is not interrupted.

Fig. 2 illustrates the simplicity of construction of the reverse current relay. It is designed with few moving parts, well insulated, is so arranged that it will operate on a reversal of 2 amperes of secondary current, and requires but 20 volt amperes for its operation. The relay is enclosed in a dustproof case, suitable for installation on a switchboard, and has a black oxidized finish. The dimensions of the relay are: width, 6 in.; height, 8 in.; depth 4 in.

New Companies

The Peace Valley Light & Power Company, Limited, has been incorporated with capital $50,000 and head office Peace River Crossing, Alta.

The Southern Electric Light & Power Company has been incorporated with head office Montreal, and capital $500,000. It is stated to be the intention to operate in the counties of Nicolet, Lotbiniere, Arthabasca, Yamaska, Drummond, Richelieu and Megantic.

The Canadian Electrical Association are taking steps towards co-operation in the placing of joint orders for electrical supplies. It is felt by most of the member companies that benefit will accrue not only to the purchasing company but also to the man on the street who buys electrical utilities and supplies from the organization which furnishes him with light and power. Further advantages in standardization of appliances are hoped for, resulting from a large number of companies placing orders for identical equipment.

Rectifier Bulb Life

Some excellent reports have been received recently on the life of mercury rectifier bulbs used on constant-current arc lighting circuits. These bulbs are guaranteed for an average life of 500 hours, but this guarantee is being generally exceeded, and in some instances an average life as high as from eight to fifteen times the guarantee has been obtained. A report of the Peoples Gas and Electric Company of Savanna, Illinois, recently issued, is an excellent example of what results are often obtained with but a slight attention on the part of the operators. This report showed an average bulb life for the last three years of 8,398 hours. It should be noted that this life is not the individual life of bulbs but the average life, for some bulbs still in service, are operating in the neighborhood of 9,000 hours. Mr. T. P. Bowen, manager of this plant, attributes this extra long average life to the fact that the bulbs are, as per instructions of the manufacturer, operated on short circuit for four or five minutes each night before throwing on the lamps. In addition to this treatment, the bulbs are occasionally taken from the tank and "rested" for a week or more and are also given an occasional hot water bath.

New Attachment Plug

The Trumbull Electric Manufacturing Company are placing on the market a new swivel attachment plug as shown in the accompanying illustrations. Claims made for this plug are that it is easy to wire, roomy, constructed of fireproof material and the easiest to open on the market. By pressing down on the catch shown the bottom drops out and the plug is open.

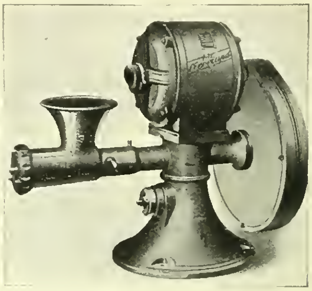
New Attachment plug —closed and open.

The Ferranti Electrical Company of Canada announce that they are in receipt of a large stock of standard meters from the Bruce Peebles Company which shipment arrived only a day or two before war was declared between England and Germany. In this respect the Ferranti Company consider themselves specially favoured in that they will be able to look after the needs of their customers and make shipments without delay until such time, in all probability, as the present situation is adjusted. The order includes as well a large stock of single and three-phase pole type transformers which came to hand by the same shipment.

As our readers have probably been made aware the Ferranti meter has been built in Toronto for several months past. By this arrangement the utmost flexibility has been obtained as, with a smaller total expenditure, a stock of the parts necessary for building up a large number of these meters of practically any standard size and type is always on hand. Their present stock of parts is sufficient to make up some 8,000 meters. Whether as a result of their own foresight or of a piece of good luck, or a combination of these, the Ferranti Company should be congratulated in finding themselves in such a fortunate position at the present critical period in our industrial supply conditions.

Motor-Driven Meat Chopper

A noteworthy feature of the motor-driven meat chopper shown in the accompanying illustration is its extreme simplicity. It forms an exceedingly compact unit, with all working parts totally enclosed so that it is perfectly safe and is readily kept clean. Finished in red and aluminum bronze it forms an ornamental addition to any butcher shop. The height is 23 inches, width 16 inches, length 28 inches, and weight 240 lbs. With a ½ h.p. motor, its capacity is 350 lbs. of beef per hour; and with a ¾ h.p. motor, 375 lbs. per hour. The chopper can be removed and placed in the cooler so that cleaning after every run is unecessary. It is made by the Cleveland Electric & Manufacturing Company, Cleveland, Ohio, and is driven by a Westinghouse Electric enclosed motor.



Trade Publications

How the Chief Engineer was Convinced—Booklet just published by the B. F. Sturtevant Company of Canada which describes the supposed visit of a chief engineer to their works and deals particularly with the manufacture of their turbines.

Air brake equipment—Bulletins No. 54562 and 54563, dealing with parts of air-brake equipment, are being distributed by the Canadian General Electric Company. The former deals with type S motorman's valves, the latter with triple valves and brackets. Both are illustrated.

OB Equipment.—The Ohio Brass Company have issued their catalogue No. 14, covering a complete line of perfected appliances used in the construction, maintenance and operation of electric railways, mine haulage systems and transmission lines. The catalogue consists of 600 pages of splendidly illustrated information. Both in appearance and content this publication is more like a text than a catalogue.

Mr. W. P. Dobson has been appointed Director of the Experimental Laboratories of the Hydro-electric Power Commission of Ontario. The laboratories are situated in Toronto. Following his graduation from the Faculty of Applied Science & Engineering of the University of Toronto, two years ago, Mr. Dobson was awarded one of the scholarships given by the University of Toronto Engineering & Alumni Association and in the interval has been doing research work on the electrical disturbances that affect high tension transmission systems.

Current News and Notes

Agincourt, Ont.

The first of a series of meetings to be held for the discussion of the hydro radial by-laws to be submitted on September 21st was held in Agincourt on the evening of August 5th. The chief speaker was Sir Adam Beck, chairman of the Hydro-electric Power Commission of Ontario, who explained in considerable detail the plan outlined by his Commission. It was calculated that the road will cost $40,000 per mile; the length of line at present considered is 105 miles. The speaker stated that the Dominion Government had not yet decided to grant the subsidy asked for of some $6,000 per mile and that, whatever the result of the by-law voting, construction would not be proceeded with without government aid unless it could be clearly demonstrated that the road would be a paying proposition. It was pointed out that only the highest class of roadbed, overhead construction and rolling stock would be used, so that the best of service could be maintained. Some 300 electors were present at this first gathering and were apparently unanimous in their desire for the commencement of the work at the earliest possible moment.

Berlin, Ont.

The illumination of King Street from Union Street on the north to the city limits on the south is being considered by the city council.

Bathurst, N.B.

The Bathurst Lumber Company, Bathurst, N. B., have just commenced the construction of a pulp mill which will be electrically driven. The power house equipment will consist of four 576 h.p. boilers designed for a working pressure of 175 pounds with 150 degrees superheat. Two of these will be equipped with ovens for burning sawmill refuse, the other two will be equipped with underfeed stokers. The turbine room will contain two 1875 kv.a., 60 cycle, 2400 volt bleeder type turbines (Canadian Westinghouse) together with jet condensers and necessary exciters. The current will be stepped down to 550 volts through a bank of single phase transformers, and the motors will be 550 volt machines. There will also be a small bank of lighting transformers to supply the requirements of all the buildings in connection with the mill. The switchboard equipment will consist of all necessary generator panels, transformer panels and about nine or ten feeder panels. Mr. A. A. MacDiarmid is the power engineer.

Belleville, Ont.

By a majority of 665 to 22 the electors voted to grant a ten-year lighting franchise to the Trenton Electric & Water Company. Along the main streets nitrogen filled tungstens will be used with series mazdas in the residential districts.

Bolton, Ont.

The recent by-law authorizing the council to take over the plant of the local company and to close a contract with the Hydro-electric Power Commission for a supply of power was carried by a large majority.

Chilliwack, B.C.

The new street lighting system recently installed by the British Columbia Electric Railway Company in Chilliwack, the terminal of the company's Fraser Valley line, has received the unqualified endorsation of the citizens. The system embraces 102 street lights of 100 watt capacity each, and covers the business and residential portions of the city. Formerly about eighty lamps of 32 candle power were in use, and the improvement is marked. Better still, the cost of the new service, covering treble the candle power per light, is the same as was paid under the old contract.

Dresden, Ont.

A by-law was carried on July 21 by a large majority authorizing a contract with the Hydro-electric Power Commission of Ontario for a supply of electric energy.

Edmonton, Alta.

Another power offer has recently been placed before the city council of Edmonton by Sir John Jackson, consulting engineer. The source of power would be the Rocky Rapids on the Saskatchewan River some 160 miles west of Edmonton. Three developments are proposed, which at the low water period will give, it is said, a minimum of 35,000 h.p. It is stated that the council is inclined to look on this proposition favorably, granting a franchise on a semi-profit-sharing basis.

Tramways, Limited, is a new company formed for the purpose of constructing a railway line from Edmonton to Fort Saskatchewan via Nanao, a distance of 18 miles. This company together with the Edmonton Intururban Railway Company is negotiating with the city with a view to securing running rights to some central point within the city limits. If a tentative agreement can be reached the ratepayers will probably be asked to vote on it.

Hantsport, N.S.

The new plant has been installed and the street lighting system placed in operation. Forty watt tungsten lamps are placed on wooden poles every 200 feet.

Hawkesbury, Ont.

A scheme is now being carried out for developing 10,000 horse-power at Bell's Falls, on the Rouge River, P.Q., for Thomas Ross and Son, merchants, of Hawkesbury. This is supplementary to a small power plant at present operated by the same firm. Owing to a horse-shoe formation of the river near the falls, the plan of development includes the construction of a tunnel from the dam, at one side of the bend, under a hill to the other side of the bend, where the power house is situated. This tunnel is being cut out from solid rock. The Rouge River empties into the Ottawa River, and in order to supply power and lighting to Hawkesbury, Vankleek Hill, the Riordon Pulp & Paper Company and others on the south shore, a submarine cable, supplied by the Canadian British Insulated Company, will be laid across the Ottawa River. This cable will be 4,200 feet, and of 22,000 volt working pressure. The plant will distribute power over a distance of about 27 miles, part of the present distribution system being utilized. Turbines will operate under 50 feet head.

Contracts have been let for the electrical equipment. The order for three 2,000 kw. generators, 2,300 volt stepping up to 17,500 volts; three 3-phase, 2,000 kv.a. transformers; a 75 kw. water-wheel driven exciter, and a 75 kw. motor-generator set has been secured by the Canadian General Electric Company, while the switchboard will be supplied by the Canadian Westinghouse Company. L. A. Herdt and W. Kennedy, Jr., Montreal, are consulting engineers on the electrical and civil sections respectively.

New Denver, B.C.

The power plant of the New Denver Light & Power Company was recently destroyed by fire. It is said the plant will be rebuilt at once.

Halifax, N.S.

The Nova Scotia Telephone Company cut in a new exchange on July 25th known as the "Lorne."

Indian Head, Sask.

Tenders are called by the Deep Lake Rural Telephone Company for the supply and construction of a complete telephone system.

Lethbridge, Alta.

For the first six months of the present year the municipal street railway system has a deficit of over $19,000.

Lachine, P.Q.

With a view to provide an additional unit for use in case of emergency, the city of Lachine have obtained tenders for a horizontal turbine pump direct-connected to electric motor, which will be installed at the water works power house. The pump will have a capacity of five million U. S. gallons, per 24 hours, against a total head of 80 pounds (exclusive of suction lift which will be 12 feet) when operating at its proper speed. The pump will be direct-connected to a 3-phase, 60-cycle, 2,200 volt squirrel cage induction motor. The wiring between the motor and starting equipment and control panel and between panel and the bus bar will be in conduit. The control panel is to be equipped with a 5 amp. a.c. ammeter, with 400 amp. scale; a t.p., d.t., 2,500 volt, 500 amp., automatic oil switch; a t.p., s.t., 2,500 volt, 200 amp., non-automatic oil switch; two 400—5 amp. current transformers; a 2,200/110 volt potential transformer with fuses, and a volt meter with 175 volt scale.

The city of Lachine, P.Q., is about to install a conduit and house and street lighting system, from First Avenue to Broadway Street, a distance of 12,000 feet, practically the whole of which runs parallel with the canal. The conduits will contain seven ducts, of tile and fibre, which will provide for 2,200 volt wires for house lighting, 6,000 volt wires for street lighting, and wires for the fire alarm system, leaving three spare ducts. There will be 44 manholes. The power for the street lighting will be supplied by the Montreal Light, Heat and Power Company. The system will be series lighting by means of nitrogen filled lamps supported on 103 iron standards. The lamps will be placed 14 feet from ground to globe. The standards will be 100 feet apart, one being placed at the corner of each street. This system will replace one of arc lights placed 600 feet apart.

For lighting the houses on the main street branch conduits will be constructed 75 feet down each side avenue; the current will be carried up a pole and transformed from 2,200 to 110 volts and then distributed by service wires running at the back of the residences. Thirty transformers are to be provided. The other houses on the side streets will be lighted as at present from the existing poles. Mr. V. H. Dupont, of the firm of Dupont, Roy & Baudouin, Montreal, is the city engineer, and the contract for the work has been let to Dietrich, Limited, Montreal.

Moosimin, Sask.

The Ivanhoe Rural Telephone Company have awarded a contract for the construction of their telephone system to the Canada West Electric Company, of Regina.

Montreal, Que.

Mr. W. H. Rosevear has been appointed Canadian manager of the Independent Pneumatic Tool Company, Aurora, Ill., who have opened a branch at 334 St. James street, Montreal. The company are makers of "Thor" electric drills with universal motors for operating on d.c. or a.c. for 110 or 220 volts.

The Montreal Electric Service Commission have invited tenders for an additional conduit, about 600 feet, from the end of St. Lawrence Boulevard to the harbor front.

The Montreal branch of the International Brotherhood of Electrical Workers have asked for a change in the conditions of labour. The most important clause of the agreement which they desire asks for the employment by contractors of union men only, or those holding a permit from the secretary of the union. It is also sought to obtain the appointment of a board of arbitration in case of dispute. The hours of work are to be nine per day, with time and a half for all overtime up to 10 p.m., and after that double pay, provided the men work continuously. Forty cents an hour is the minimum wage, foremen having three or more helpers receiving 45c an hour. All board and expenses of men on out-of-town work must be paid by the contractors. Under a penalty of a fine, men are to be prohibited from doing private work of any kind while employed under terms of the agreement.

During the year ended June 30 last the earnings of the Montreal Tramways Company totalled $7,142,804, an increase of $388,576, or 5.75 per cent.; while the expenses were $4,206,114, a gain of $173,450, or 4.30 per cent.; and the net earnings $2,936,689, an addition of $215,126, or 7.90 per cent. The ratio of operating expenses to earnings was 58.89 per cent., compared with 59.71 last year, which is considered satisfactory. After deducting the city's share, bond and debenture interest, and taxes, the net is $736,836, an increase of $98,505. The dividend absorbs $242,056, leaving a surplus of $494,780, of which $82,236 is appropriated to discount on bonds sold, and $275,000 to contingent renewal account, the balance of $137,543 being transferred to general surplus. The number of passengers carried was 168,472,952, car earnings per passenger 4.11, transfers 58,120,066, total passengers carried 226,593,018, and car earnings per passenger total carried 3.05. The sum of $829,706.18 was expended on the maintenance of the company's properties, plant and equipment, and charged to operating expenses. This amount, together with the amount of $417,124.99 charged to renewal account makes a total expenditure of $1,246,831.17 during the year on the upkeep of the company's properties. This amount is equal to 17.46 per cent. of the gross earnings.

Large additions were made to the rolling stock of the company during the past year. A new type of motor car and trailer very materially helped the service on St. Catherine street, its main line, and the company is now considering the advisability of building more cars of this type as requirements may warrant. The increased rolling stock and extensions made necessitated further extensions of the power requirements, which has also been materially increased during the past year. The company has also completed a large portion of the rebuilding of its track, which it is proposed to continue as fast as possible.

The Northern Electric Company has recently received a large contract for the Montreal Light, Heat & Power Company which covers approximately 80,000 feet of 300,000 c.m. 3-core, 13,200 volt paper-insulated, lead-covered power cable. Two stretches of this cable run from the M. L. H. & P central station on Ottawa street to their Cote St. Paul station, while five lengths are to be laid tying in their Cote St. Paul station with their new LaSalle steam plant.

At the annual meeting of the Canadian Light & Power Company the old board of directors and executive were elected as follows: F. Howard Wilson, president; E. A. Robert, vice-president; George G. Foster, K.C.; J. M. McIntyre, N. Curry, R. N. Smyth, Wm. C. Finley, H. J. M. Wilson, F. J. Shaw and J. W. McConnell.

At the meeting of the Montreal Public Service Corporation two additions were made to the board, P. J. McIntosh, of New York, and Hon. N. Curry being the two new members.

Nelson, B.C.

R. A. Brown, city electrician, Calgary, visited Vancouver and other Coast points recently. On his way west Mr. Brown took in the Chaka Mika carnival at Nelson and inspected the city power plant, of which he had charge prior to his removal to Calgary.

North Vancouver, B.C.

By a vote of 325 for to 130 against, the ratepayers of the city of North Vancouver declared in favor of purchasing the franchise and holdings of the Vancouver Power Company on the north shore of Burrard Inlet. The question will be decided by the council of 1915. Had the by-law been defeated no action could have been taken again until 1924.

Outremont, Que.

A contract for 1,500 nitrogen-filled lamps for the street lighting system of Outremont, Que., has been awarded to the Northern Electric Company, Limited. The same company have been given an order for 23,000 feet of lead-covered cable and 3,000 feet of armoured cable. The illumination standards will be supplied by the William Hamilton Company, of Peterborough.

Port Arthur, Ont.

A by-law was submitted on August 6th authorizing the expenditure of some $33,500 for street railway extensions.

Prince Rupert, B.C.

The city of Prince Rupert at present is developing electricity by means of a steam plant, but has money in hand for the installation of its own hydro-electric plant to be constructed at Lake Woodworth. Several years ago the Prince Rupert Hydro-Electric Company acquired the charter of a pioneer concern which proposed to develop electric energy from Falls River and Khtada River, about thirty-five miles up the Skeena River, and the right to do business in the city has been sought for some time without success. The request is being vigorously opposed by many of the citizens, who see in it the destruction of their plans for the financial success of the city-owned plant. William Manson, M.P.P. for Skeena district, Mayor Newton, of Prince Rupert, and city engineer Mason, passed through Vancouver on July 16th en route to Victoria to oppose before the executive council of the provincial government the entrance into Prince Rupert of the Prince Rupert Hydro-Electric Company until the consent of the people has been obtained in the passage of a by-law.

Penticton, B.C.

In connection with plans for the operation of an electric railway line between Oroville and Penticton, the Okanagan Valley Electric and Power Company recently acquired the Oroville electric light plant from the Similkameen Power Company, and will develop the power at Similkameen Falls to the fullest extent.

Regina, Sask.

The operation returns of the municipal street railway system, Regina, for the week ending August 1st are as follows: revenue, $6,994.40; passengers carried, 159,610.

Saskatoon, Sask.

Contracts have been awarded to the Escher Wyss Company for equipment in connection with the water works system.

Shoal Lake, Man.

Contracts have been awarded for equipment in connection with the Shoal Lake, Man., electric light plant as follows: Campbell oil engine to the Refrigeration Engineering Company, Winnipeg; generator and switchboard, pole line materials and construction to the Canadian General Electric Company; power house building, E. R. Snider, Shoal Lake. The John Galt Engineering Company are consulting engineers.

Stratford, Ont.

On August 1 the new street lighting system was turned on in Stratford, Ont. The lights used are nitrogen-filled tungstens.

Shawinigan Falls, Que.

The Belgo Canadian Pulp & Paper Company, Limited, will in the near future install a 500 h.p. steam turbine, the slow speed shaft to run 250 r.p.m. The steam pressure on the turbine inlet will be about 110 lbs. with a maximum of 20 lbs. pressure on the exhaust; the steam to be used for heating purposes.

St. John, N.B.

The New Brunswick Hydro-electric Company are attempting to arrange a schedule of rates with the city council of St. John. Following this it is stated to be the intention of the company to proceed with their hydro-electric developments.

St. Thomas, Ont.

Negotiations are proceeding between the representatives of the interested municipalities and representatives of the London & Lake Erie Railway & Transportation Company looking to the extension of the latter's line from St. Thomas to Aylmer.

Victoria, B.C.

The sum of $75,000 voted at the last session of the federal parliament, will be expended in the extension and improvement of the Dominion telegraph service on Vancouver Island. The construction of a line almost to the northern end of the Island will alone cost about $50,000. From the station at Campbell River the line will be run to Hardy Bay, thence across the Island to Quatsino Sound, and from there to Halberg and San Josef Bay, thereby giving a number of outlying settlements a long desired connection with the outside world. The line up the northern portion of the Island will also be of great service to the Fisheries Department and the Forestry Board. The minor extensions decided upon, include a wire from Clayoquat to Pharmigan, a settlement located on the Bear River. This will serve the mines at Pharmigan and Kalappa as well as the Mosquito Harbor Lumber Company. Another extension will run from Ganges, Salt Spring Island, by way of Fulford Harbor, Isabella Point and Pier Island to Sidney, thus furnishing an additional outlet to the Gulf Island system. The telephone service between Victoria and William Head quarantine station is also to be made thoroughly modern.

Wapella, Sask.

Tenders are called by the Great West Rural Telephone Company for the supply of material and the construction of ten miles of telephone system.

Watrous, Sask.

The Little Manitou Rural Telephone Company has awarded a contract to the Prince Albert Electric Company for the supply of material and the construction of a telephone system.

Walkerville, Ont.

The Walkerville Light & Power Company have been negotiating with the local hydro-electric commission looking to the purchase by the latter of the company's generating and distributing plant. It is understood that the negotiations have temporarily fallen through.

Winnipeg, Man.

The British-Canadian Engineering & Supply Company, of Winnipeg, have just secured the contract for the installation of a suction gas engine and producer plant for the town of Oxbow, Sask.

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Generation, Transmission and Application of Electricity

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The War and Canada's Trade

Now that the more or less panicky feeling has considerably subsided, which this continent, in common with the rest of the civilized world, experienced when the declaration of war by the German nation was announced, and now that we are able to look the situation squarely in the face, it is generally conceded that there are many probable developments in connection with which Canadians may well feel hopeful and full of courage. Chief of these is the almost certain extension of her manufacturing and trade connections.

The eminent economist, Sir George Paish, takes the view that the present war will open up a tremendous opportunity for Canada and the United States. It is held that if the tide be taken at the flood it will mean not diminished, but greater, prosperity for us. Financial embarassment may, indeed, be experienced for a time, but this is an evil which will be common to practically the whole world. With the maintenance of ocean traffic and the opportunity to dispose of our farm and factory products the speediest recovery will surely come to Canada. Activity in new lines will compensate for depression in others. Far removed, we trust, from the scene of hostilities, the internal trade of this country should suffer as little as any in the world.

* * *

An examination of actual facts and figures cannot but be reassuring to the manufacturing and trade interests of Canada. We find that in the fiscal year ending March 31 last, our exports and imports represented a total value of more than a billion dollars—the highest figures in our country's history. In this period a great stride was made in our exports, which amounted to nearly $432,000,000. The amount of trade carried on with the present enemies of the Empire was inconsiderable, our exports to Germany and Austria-Hungary combined amounting to less than four and one-half million dollars, while our imports from these countries were about four times as great. It is questionable, therefore, whether it would not be in Canada's favor if the exchange of business were wiped out. Naturally the war will affect adversely the buying power of many European countries, but it must be remembered that our business with Continental Europe constitutes only a small part of our external trade, and that it is the other colonies of the British Empire, and the United States, that are our best customers. Canadian total exports to Continental Europe last year amounted to less than twenty million dollars, while our commerce with other parts of the Empire consisted of exports to the value of some $239,000,000 and imports amounting to $154,000,000—a total of $393,000,000. With the United States, our trade consisted of exports amounting to $200,000,000 and imports valued at $411,000,000 a total of $611,000,000. Thus our trade with other parts of the British Empire and with the United States amounts to upwards of a billion dollars. With these things in mind and the knowledge that Germany's merchant vessels are being driven off the sea, one may surely conclude that ultimately the war will have a good effect upon British (including Canadian) and United States trade. It is also reasonable to expect that much of the German competition which British and Canadian manufacturers have had to cope with in the past will be wiped out and that Canada will share in the transfer of the trade which Germany will lose.

* * *

We must not, of course, overlook the fact that one of the most likely results of the war will be a world-wide scarcity of capital for investment purposes. It is impossible to forsee in detail the far-reaching results of the changes that are taking place in the value of capital, but a natural outcome is that constructional works and public improvements will be considerably delayed. Activity, however, will be all the greater when constructive enterprise begins its forward march. All the more necessary, then, for us to be prepared to take full advantage of it.

After the Napoleonic wars, one hundred years ago, it was not long before England was on the quick march to prosperity. Marked improvements took place in almost every branch of domestic industry; funds rose, revenue increased, manufactured lines were in great demand, money was abundant, sales of land improved, gold reappeared, and depression gave place to hopefulness and enterprise. We can glean encouragement from the pages which record the experience of other days.

* * *

It is to be hoped that the great majority whose faith in Britain's, and with it Canada's, destiny is unalterable, will rise to the present emergency by united effort and preserve the internal stability of the Empire and her colonies. There is ample reason to believe that even with a continuation of the war for some time, there will arise new demands for industries to offset those that are cut off. From now on the factories of Germany and France, depleted as they will be by the call to arms, will scarcely be able to meet the demands of home consumption. Here, then, will be the opportunity for Great Britain, Canada and the United States, in which Canada should play an important part, all the more so in that we possess a wonderful variety of raw materials without going outside our own borders. Markets will arise in other parts of the British Empire, and these will be

strengthened by a feeling of great reliance in Canadian products. It is an ill wind that blows nobody good, and possibly one of the most marked benefits that will arise out of this terrible conflict will be the stimulus afforded the manufacturing industries of the North American continent. The cessation of imports from continental Europe into England and Canada will give many home industries an unexampled opportunity for immediate development on an enterprising scale. Canada has a home demand which must be satisfied, and, with the untold natural resources of the country, we can look with confidence to the supply from within. Much of the new trade will be held, and so Canada will prosper at the expense of her former continental competitors

* * *

Already there is evidence that the normal channels of trade are being diverted towards Canada. Certain British manufacturers who have relied on German raw material are looking elsewhere for supplies. The Department of Trade & Commerce at Ottawa report numerous inquiries regarding Canadian resources and trade possibilities. Viewed as a cold money proposition it is probable that no other world movement could have been as immediately effective in bringing Canada and her resources so prominently into the limelight. For whatever it is worth at a time like the present, the financial advantage surely rests with us.

Electrical Contracting a Profession

We ask special attention, particularly by electrical contractors and architects, to a typical and, as we believe, a model plan and specifications for the wiring of a private residence designed for the man of average means and which would be suitable for probably, the great majority of the houses of the present day. It will be readily conceded that far too little attention has been paid to the correct and scientific designing of the electric work in private residences. This has been due as much to the negligence of electrical contractors themselves, who are sometimes incompetent, as to architects, who naturally are not in a position to appreciate to the fullest extent the value of a proper wiring installation. The architect's training fits him to design either artistic or convenient houses or a combination of both and naturally he cannot be in touch with the exquisite refinements of modern electricity any more than the electrical engineer can be expert in artistic design. There is not, however, the same excuse for the electrical contractor.

That electrical installations in buildings of all sorts are worthy of the attention that is latterly being paid to them is amply attested by the people who have experienced the conveniences and luxuries of a modern scientifically laid out system. The demand for it is further shown by the number of consulting electrical engineers who at different points throughout the Dominion are specializing in the design and oversight of the work of the electrical contractor. A few weeks ago we published a complete set of plans and specifications prepared by one of these firms of consulting engineers having special reference to an office and warehouse building of the larger type. The general interest created by this article is the direct cause of the publication of a similar article in the present issue on the plans and specifications for a private residence. We believe this article contains valuable and helpful suggestions for every electrical contractor operating in Canada whatever his training or experience may be. Quite possibly there are a few who will be of the opinion that the article over-elaborates the subject of electric wiring. We do not think so. The only argument that can be advanced against any of the little refinements used, is expense; yet the electric work in this house would not mean more than, at most, 2½ per cent of the total cost of the building.

When the day arrives that the architect or owner realizes that his electric installation is of sufficient importance to have definite plans and specifications drawn up along lines similar to those detailed in this article the work of the electrical contractor will be facilitated almost beyond conception, a big advance will have been made towards standardization, the work of the inspector will be infinitely reduced and the householder will have a reasonable guarantee that the installation he is paying for will fulfil adequately the purpose for which it is designed.

Wooden Pole High Tension Lines

Reference is made elsewhere in this issue to the erection of an "A" frame wood pole construction transmission line which will carry 100,000 volt energy and the same item states that at the present time the company making the installation have in operation both a 60,000 and an 80,000 volt line. This is exceedingly interesting in view of the fact that it has generally been taken for granted that above voltages of 50,000, or at most 60,000, wooden poles were useless for transmission lines and could only be replaced by steel towers. Doubtless the life of the wooden tower line will be a consideration, but with modern methods of preserving wooden poles and considering also that changes in the art of high tension transmission have so far always required changes in tower line construction before the limit of the line's life has been reached, it is evident that the wooden pole is a contending factor in high tension transmission.

In this connection an interesting statement was made by Mr. Chas. E. Waddell in a recent discussion, before the A. I. E. E., of a paper on the subject "High Tension Transmission Lines." Mr. Waddell is quoted as follows: "As to the question of grounded steel towers versus wooden supports, I confess that at the present state of the art I am leaning back toward wooden pole construction with wooden arms and non-grounded fittings. I have in mind a line where a steel tower line is paralleled by a wooden pole line, both 60,000 volts, from the same transformers. The wooden pole line is of standard conventional cross-arm construction with pin type insulators. The steel tower line is equipped with suspension insulators. The interruptions on the suspension insulator line have been too numerous to count while the wooden pole line has yet to have its first interruption."

U. S. House Passes Water-Power Bill

The so-called Adamson bill, relating to the construction of dams across navigable streams, was passed by the House of Representatives of the United States on August 4. In accordance with its requirements, plans and specifications for such dams must be approved by the Secretary of War and the Chief of Engineers before work of construction is commenced. Approval may include the condition that water-power to operate locks, etc., be supplied without cost, or a reasonable annual charge may be made for the benefits that accrue to the grantee by the authority given under the act. The dam shall be so located as to be best adapted to a comprehensive plan for the improvement of the waterway for the use of navigation and for the full development of the water-power. The rights granted under the act extend over a period of fifty years beginning on the date of the original approval. Upon two years' notice prior to the expiration of the grant the United States has the right to take over the property of the grantee necessary and useful for the generation, transmission and distribution of energy, the payment therefor being based on the actual cost of the lands pur-

chased and used by the grantee and the fair value of the other properties taken over. Allowance will be made for deterioration but not for good will or profit in pending contracts. The Secretary of War is empowered to prescribe reasonable rates of charges for energy transmitted in "interstate or foreign commerce." When the energy is used within a state having adequate regulation for rates and service to the consumer the Secretary of War will not interfere with the established rules for rates and service.

Treating Employees Right

As illustrating the generous treatment by electrical (and other) Canadian companies of such of their employees as are enlisting for war service, the following bulletin just issued by Mr. J. S. Norris, general manager and secretary-treasurer of the Montreal Light, Heat & Power Company, is typical:—

The management is pleased to announce that employees of the permanent force enlisting for active service under British Arms in First Canadian Contingent will retain their status as employees as regards Pension Fund and all other benefits with allowance of difference in pay between Government rate and present wages from date of enlistment to date of discharge or death (not exceeding one year) provided in the former case enlistment and discharge papers are submitted to the company promptly after disbandment of contingent. If desired accrued pay as above will be paid fortnightly to employees' dependents on order. Special bulletin will issue in the event of organization and dispatch of further Canadian contingents.

Overseas Trade Practically Normal

Contrary to fears expressed in the early hours of the present European war the avenues of trade in Canada and Britain have been kept practically clear of danger. Shipments have continued almost as usual and unless unforseen difficulties arise there is little danger that the Canadian market will suffer from the inability of the British manufacturer to deliver his goods. Already the situation has adjusted itself to the extent that insurance rates have become almost normal and a number of shipments have arrived during the week. The present indication is that British manufacturers will suffer chiefly from the lack of raw materials, but several firms report ample supplies for many months to come. That Britain should be engaged in a death grapple with Germany and at the same time be enabled to carry on without molestation her over-seas commerce, is one of the most striking incidents of this unparalleled situation.

Ten Commandments of Safety

At the Lorain Steel Company's plant at Johnstown, Pa., the following ten commandments have been adopted for the guidance of the employees:

1. Thou shalt have no other thoughts than thy work.
2. Thou shalt take no unnecessary risks, nor try to show off, nor play practical jokes, for by thy carelessness thou mayest do injuries which will have effect unto the third and fourth generations to follow.
3. Thou shalt not swear, nor lose thy temper when things do not come just right.
4. Remember that thou art not the only one on the job and that other lives are just as important as thine own.
5. Honor thy job and thyself that thy days may be long in employment.
6. Thou shalt not clean machinery while it is in motion.
7. Thou shalt not watch thy neighbor's work, but attend to thine own.
8. Thou shalt not let the sleeves of thy shirt hang loose, nor the flaps of thy coat be unbuttoned, as they may get caught in the machinery.
9. Thou shalt not throw matches or greasy waste on the floor, nor scatter oil around the bearings, as a dirty worker is a clumsy worker, and a clumsy worker is a menace to his fellow workers.
10. Thou shalt not interfere with the switches, nor the dynamos, nor the cables, nor the engines, nor anything else thou art told is dangerous.

Interesting Service Decisions

The following interesting decision regarding service relations has been handed down by the New Jersey Public Utilities Commissioners as reported in "Rate Research" published by the Rate Research Committee of the National Electric Light Association. The complaint of one Max Taub against a public service electric company based upon the refusal to furnish service was dismissed.

The company refused service because of the failure of the complainant to provide for the grounding of transformer secondaries inside his own premises as required by the company's rules. The decision reviews expert testimony in regard to the grounding of secondaries of transformers, the object of grounding, objections to grounding, methods of grounding and the most approved method.

The board states that after extended investigation the Board entered an order effective January 1, 1914, puting into operation "Rules, regulations and recommendations for electrical supply utilities and for all utilities owning and using poles and wires."

This order, which is still in effect, provides among other things that—

> "XIV. The rules contained in the 1913 edition of the National Electric Code regarding grounding of secondaries are hereby adopted for all new connection. . . ."
>
> The order is general. The rule laid down by it is applicable to all companies under the jurisdiction of the Board.

The rules contained in the 1913 edition of the National Electric Code regarding grounding of secondaries, and adopted by the Board are found in Section 15. In so far as they are pertinent they are set forth in the decision and the Board finds that the Company's rule is in accord with the order of the Board.

> It is urged by the complainant that the cost of the inside ground wire should be borne by the Company, and not by consumer. In considering the complaints of Fernando W. Meyer and Joseph McBride, the Board concluded that the house wiring included the running of the inside ground wire, and the cost thereof should consequently be borne by the consumer. The present record discloses no reason for changing this conclusion.

Electrolysis

The possible detrimental effects of making such connections upon the City's system through the action of electrolysis was considered. Expert opinion is quoted as follows:

> "Alternating current, of a frequency as is used for electric light and power for buildings in Hoboken, * * * is current which reverses in direction one hundred and twenty times every second. When such a current flows between an iron pipe and surrounding soil, there is only a neglible effect from electrolysis." . . . .
>
> " * * * the practice has been followed in so many places without any case of injury to the water pipes being detected that objections of this sort can easily be shown to be unreasonable."

The National Electrical Code (ed. 1913), too, contains this note (p. 29):

"Companies and Departments in charge of water works are urged to allow the attaching of ground wires to their piping system in full confidence that the integrity of such piping system will not in any way be affected, whatever may be the normal voltage."

After full consideration of the case, the Board dismissed the complaint.

BREAKDOWN OR AUXILIARY SERVICE

This is a decision of the New York Supreme Court reversing a previous decision of the Public Service Commission that the New York Edison Company is justified in not furnishing certain auxiliary service. The court holds that the company's reasons for refusing to furnish electric current are untenable and that the restrictive clause which it insists on inserting in this contract, and to which objection is taken by the customer, is contrary to public policy and invalid, and constitutes in no proper sense a reasonable regulation respecting the use of the service demanded.

Refusal of Service

The decision cites that the New York Edison Company is a public service corporation holding a franchise from the city and enjoying valuable privileges not generally granted to a private individual or corporation for its own individual benefit, not the least of which is the right to use the public streets and highways for carrying its conduits. Having undertaken to perform a public service and accepted certain provisions in connection with the undertaking it is bound to serve impartially every member of the community who demands this service and stands ready to pay therefor and to comply with proper and reasonable regulations respecting said service.

Not only is the company under this obligation by the common law but it is expressly required by statute to furnish electricity for light upon the application of the occupant of any building or premises within 100 feet of its mains or wires, as it is conceded that this would-be customer's premises are. The same duty is imposed by the Public Service Commission's law. The Supreme Court of the United States has said "that a public service company must render the service for which it obtained its charter to those within reach of its facilities without distinction of persons."

It is urged by the company and apparently agreed to by the Commission that the company in any event is not obliged to furnish electricity for power and refrigeration purposes. In the opinion of the Supreme Court of the United States the company's duty to furnish service, however, does not rest upon the statute alone but upon the common law obligation as a public service corporation, which requires it to serve impartially every member of the community. It may be that if it did not undertake to furnish electricity for power purposes to any one it could not be coerced to do so. It does, however, profess to undertake to furnish electric current for power purposes and this it does by virtue of its franchise as a public service company. So professing and undertaking, it cannot arbitrarily pick and choose whom it will serve and whom it will not.

Terms and Conditions

It is, of course, the rule that such a corporation may establish reasonable regulations respecting the use of the service which it proposes to furnish, and each customer requiring the service is called upon to comply with such regulations. In our opinion, however, the requirement that a consumer must take all of its electricity from one company, or receive none at all, is not in any proper sense a regulation respecting the use of the service, but is a purely arbitrary attempt on the part of the company to insure to itself a monopoly of furnishing electrical current. If the company can lawfully decline to furnish any current to this relator because he also proposes to obtain electricity from a neighbor (not a competing company) it can equally well refuse to furnish electrical current to a consumer who himself generates a part of the current which he uses. Such a limitation upon the company's obligation would, as it seems to us, be quite unreasonable.

Limited Hour Service

An attempt, not thoroughly successful, was made before the Public Service Commission to establish the fact that relator sought to use the company's current only during those hours that it would be most expensive to produce it. If that be so, the situation could be readily met by establishing a rate for such service; but it is probably not so, for it surely must be that a very large proportion of the company's customers use electricity only at night and not at all in the daytime, and yet no one would say that it would be reasonable for the company to refuse to furnish current unless the customers would undertake to use it during the whole 24 hours of each day.

I. E. S. Convention Program

The following list of papers will be presented at the convention of the Illumination Engineering Society, Cleveland, Ohio.

Factory Lighting—By Hogue and Dicker.

Some Experiments with the Ferree Test for Eye Fatigue—By J. R. Cravath.

Planning for Daylight and Sunlight in Buildings.—By Marks and Woodwell.

Notes on the Ulbricht Integrating Sphere and Arc Lamp Photometry—By H. K. Chaney.

Effect of Room Dimensions on Efficiency of Lighting Systems—By Ward Harrison.

Relation of Light to the Critical Inspection of Documents—By A. S. Osborne.

Experiments with Colored Absorbing Solutions for Use in Heterochromatic Photometry—By H. E. Ives and E. F. Kingsbury.

A New Standard Light Source—By L. A. Jones.

Artificial Daylight—Its Production and Use—By M. Luckiesh and F. E. Cady.

Characteristics of Gas-Filled Lamps—By G. M. J. Mackay.

A Transmission and Absorbing Photometer for Small Areas—By Nutting and Jones.

Recent Improvements in Gas Lamps—By a Welsbach Representative.

Illumination of Light Shafts—By C. H. Sharp.

Portable Mine Lamp—By H. H. Clark.

Some Recent Experiments on Vision in Animals—By H. M. Johnson.

Light Filters for Use in Photometry—By C. E. K. Moes.

The Locomotive Headlight—By J. L. Minick.

Present Practice in Machine-shop Lighting—By Powell and Harrington.

The Development of Daylight—By E. J. Brady.

Lighting of the Home—By a Representative of The Duquesne Light Company.

Lighting of a Carpet Mill—By Rose and Ockley.

Color Variation in Illuminants—By Jones and Nutting.

Reflection Standards—By Nutting and Jones.

Physiological Effects of Light on the Body—By E. C. Titus.

Another Plant on the Montreal River

At Fountain Falls, in the Cobalt district—Same water used three times over—Northern Ontario a happy combination of mineral wealth and water powers

By H. E. Mueller

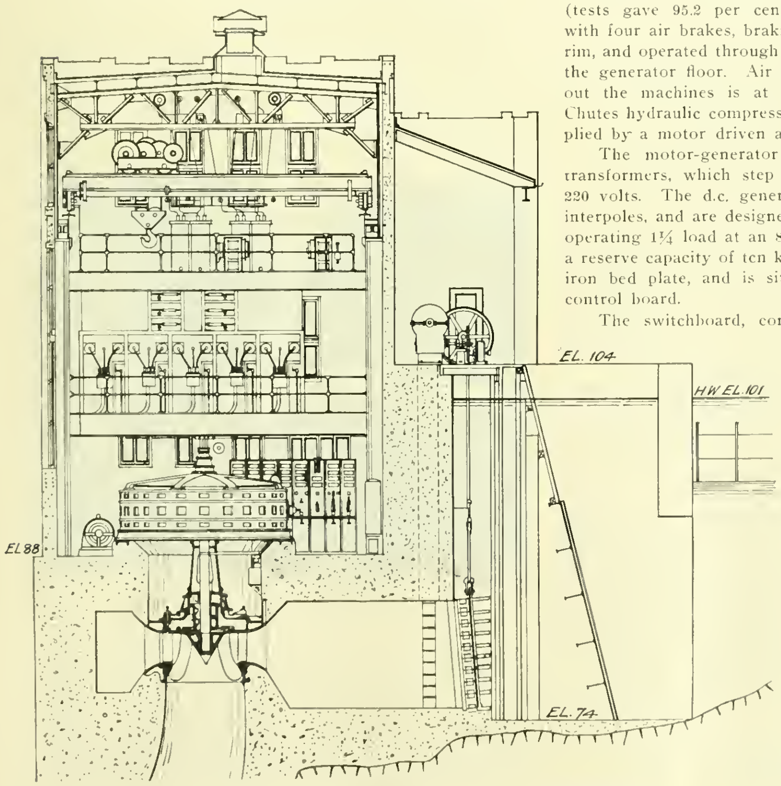
In the latter part of May, 1914, the generators at the new Fountain Falls station of the Northern Ontario Light & Power Company were paralleled with the line, on which were the Ragged Chutes, Hound Chutes, and Matabitchouan River plants, and have since been operating with these plants, supplying the Cobalt mines and surrounding towns with light and power.

This station is situated on the Montreal River, 1½ miles below the Ragged Chutes air and electric, and four miles below the Hound Chutes hydro-electric plant, all on the Montreal River.

The Power House

The sub-structure of the power house is a combination of Cyclopean and reinforced concrete. The super-structure, 26 by 66 ft. in plan and 78 feet high, is a steel frame, with reinforced concrete walls and tile roofing, covered with tar and fine pebbles, and is equipped with a 20-ton travelling crane, with electrically operated hoist. Ninety steel frame windows, with wire reinforced glass, operated from the generator floor, together with a large ventilator on the roof, give the power house all necessary light and ventilation.

At the north end of the generator floor is located the switchboard and motor-generator exciter sets. Directly above the foregoing is the oil switch and disconnecting switch gallery, over which is the lightning arrester and transformer gallery. Electrically operated field rheostats for the alternators are also on this gallery.



Section hydro-electric development plant, Fountain Falls, Montreal River.

Electrical Apparatus

The electrical apparatus consists principally of two vertical type, revolving field, 3-phase, 60 cycle, 150 r.p.m., 11000 volt, 1250 kv.a. alternators; two 52 kw., 1200 r.p.m., 220/125 volt, 3-phase, 60 cycle, motor-generator exciting sets; four 40 kv.a. oil insulated, self-cooled, single-phase, 60 cycle, 11,000/230/115 volt transformers; an eight-panel switchboard and necessary switching equipment. These were all supplied by the General Electric Company of Sweden.

The generators are equipped with one guide bearing above the revolving field, and a thrust bearing mounted on top of the generator frame which carries the total weight of the revolving element. Oil is circulated through the thrust bearing by a pump located in the generator pit and driven directly from the generator shaft. The efficiency of these generators at unity power factor, and full load is guaranteed by the manufacturers to be at least 94.5 per cent. (tests gave 95.2 per cent.). Each generator is equipped with four air brakes, braking on the lower side of the rotor rim, and operated through a motorman's air valve located on the generator floor. Air for these brakes and for blowing out the machines is at present supplied by the Ragged Chutes hydraulic compressed air plant, but will soon be supplied by a motor driven air compressor in the station.

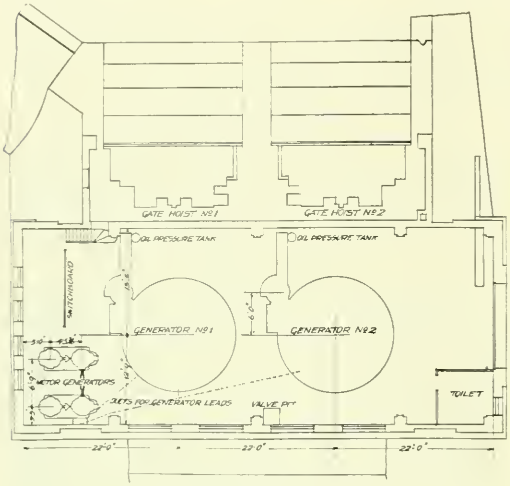
The motor-generator sets are fed from the station transformers, which step the generated potential down to 220 volts. The d.c. generators are compound wound, with interpoles, and are designed to supply both generators when operating 1¼ load at an 80 per cent. power factor and have a reserve capacity of ten kw. Each set is mounted on a cast iron bed plate, and is situated directly to the left of the control board.

The switchboard, consisting of eight panels of dark grey marble, is equipped with all necessary meters, oil switch operating levers, receptacles, plugs, etc., for synchronizing either generator with the bus or the bus with the line, and with push buttons for the electrically-operated field rheostats and the motors on the governors.

The three-pole oil switches are self contained, each set located in a reinforced concrete chamber. Directly behind the oil switches are the disconnecting switches and three-phase potential transformers. Each disconnect is separated from its neighbor by a concrete barrier. Below the disconnects is the potential transformer for that circuit, in another concrete

chamber. Each set of disconnect barriers is numbered, named and colored differently. Numbers corresponding with those on the switch barriers are on each oil switch operating lever at the switchboard and are only visible to the operator when the oil switch is open. It is thus hardly possible to unknowingly open a loaded disconnect.

The bus bars are mounted in three separate concrete compartments, and are located above the oil switches and disconnects. A line feeder and a generator feeder are on one side of each set of bus sectionalizing switches, of which there are two, and the transformer taps are in the centre, with the sectionalizing switches on each side.



Section showing Fountain Falls layout.

The lightning arresters are of the electrolytic type and were supplied by the Canadian Westinghouse Company.

Water Wheels

The turbines, designed and built by the I. P. Morris Company, are of the Francis single runner, downward discharge type and are set in a reinforced concrete scroll case chamber, having draught tubes moulded in the concrete.

The runners on these wheels are an exact reproduction, on an enlarged scale, of the I. P. Morris experimental runner, which tested out 90.05 per cent. efficiency at the Holyoke Water Power Company's test flume.

Each wheel, equipped with a lignum vitae guide bearing and a water strainer for cooling same, is rated at 1500 h.p. when operating under an effective head of 30 ft. and is guaranteed to operate at at least 87 per cent. efficiency at full load.

Governors

The speed is regulated by Pelton Type "G" oil pressure governors, shaft driven from the generator shaft and direct connected to the turbine gates. Each governor is equipped with a tachometer and a motor for distant speed control.

The thrust bearing oil pump, and the lignum vitae bearing strainer are both fitted with alarms, in case either should stop or choke up. When this happens an alarm bell rings and a signal lamp lights up on the corresponding generator panel. When a unit is shut down, the alarm bell is automatically cut out on opening the generator switch, and the signal lamp left burning.

Head Gates

The gate house, directly adjacent to the power house, contains the motor-driven head gates, stop log slots, and racks. Ten feet ahead of the racks is a concrete wier wall, extending nine feet below the operating water level which prevents ice and logs that get past the booms in the river, from coming up against the racks.

The head gates, 9 ft. 8 in. x 14 ft. 8 in., and weighing approximately 15 tons, are operated by induction motors. The bearing surface of these gates is on steel rollers, linked together, rolling on two steel rollers at each end of the gate. The gates seat in a bronze slot, and leak very little water. These gates will close and seat properly when the water wheel is operating with a full gate.

The above features were designed by Viele, Blackwell & Buck, New York, consulting engineers in charge of the whole development, and are giving perfect satisfaction.

Illumination of Plant

The power house is illuminated throughout with tungsten lamps. Five 250 watt lamps are used to light the main portion of the generator floor. Twelve 40 watt lamps, in a reflector, concealed behind a steel girder supporting the oil switch gallery, illuminate the switchboard perfectly. The rear of the switchboard, oil-switch and arrester galleries and gate house are excellently lighted with 100 watt lamps.

The Dam

The dam is of the Ogee type constructed of a combination of Cyclopean and reinforced concrete. It is 400 feet long with an average height of 12 ft. and a maximum height of 15 ft., to which will be added four feet of flash boards. The dam, as well as the balance of the development, rests on solid rock throughout.

Operation

From the description of the electrical apparatus it will be noted that this station is not "self starting," i.e., it depends on some outside current, for its initial field current for one machine. The following operations are, therefore, necessary to put one machine on the line. First, a line feeder is closed (supposing the sectionalizing and other necessary disconnecting switches to be closed) which puts the line potential, from the other stations, on the bus. The transformer switch is then closed, followed by the low tension bus knife switch, on the power panel, an exciter set started up and the alternator excited and paralleled with the bus bars. To avoid going through these same operations whenever any line trouble might open an oil switch the line switches have been set to go out first. The alternators are then exciting themselves, through the station transformers,

Exterior and interior views, Fountain Falls hydro-electric development plant.

and it is only necessary to synchronize the bus with the line and either or both units will be ready for the load.

The load consists chiefly of induction motors, generally working at full capacity, which gives the station a power-factor of 78 per cent. more or less. Several 1,000 h.p. induction motors will soon be replaced with synchronous motors, which will be operated with an over-excited field, to boost the power factor. The operators at each station are informed from the Cobalt sub-station, which is nearly the centre of distribution, of any remarkable change in the power-factor, which is generally around noon and 4.30 p.m, and they adjust their fields accordingly. In this way, the power-factor at each station is kept nearly the same.

The transmission line for Fountain Falls was simply extended from Ragged Chutes. The entire line is of single wooden poles, with two complete power circuits and two telephone lines. Each conductor is marked at every station and line tower, so that in case of several conductors breaking, a combination can be made of both lines, to get one complete circuit until such a time as the broken lines can be repaired. Up to date, however, it has never been necessary to take advantage of this feature.

The governors at this station have been set more sensitive than at any of the other plants with which it operates and as a result the Fountain Falls station responds to, and takes care of all light load changes. Recently a heavy load suddenly dropped off the line, and the one generator, then in service here, operating at the time with a full gate, dropped all its load and motored to the extent of nearly 300 kw., which kept the frequency practically normal.

Need of the Electric Vehicle Industry

is Standardization—Then will follow in natural sequence, Economical Production, Lower Prices, Larger Output—The last two items especially interdependent

Henry Ford may well attribute the success of his immense business to the one-model idea. "The best little car for the money" arrived only through sticking to one standardized design and backing that design by quantity production of a magnitude that is almost unbelievable. The whole success of the automobile industry has hinged on production. Without it we would have had retail prices sufficient to retard our present "one million, plus" registration for another decade.

Without venturing to predict what effect quantity production would have upon the electric passenger vehicle, we do not hesitate to state that quantity production is the greatest immediate need of the electric truck.

The older manufacturers have reached a standard design which is accepted as practical by all really familiar with the needs of road transportation. The operating efficiency of the high grade electric truck is no longer questionable; neither is the fundamental superiority of the electric over the gasoline truck in the former's economic field. The development work has been done. What we now need is standardization and production on a large unit basis.

It is one of the anomalies of the industry that many competent engineers, purchasing agents and general managers will pass by the standard model at a fair price and insist on a truck built to their own specifications. Not every manufacturer will humor them (for eliminating the demands of certain trades and a small percentage of unusual operating conditions, that is all it amounts to) but if they can get their ideal of a good truck manufactured at all they are often willing to bear the big premium and the long wait in delivery which this entails. The special truck is frequently less of an operating success than the standard model would be, but that in some cases appears to be a secondary consideration.

Buyers Not Wholly to Blame

But perhaps the prospective buyer is not wholly at fault. Let a new manufacturer of electric commercial vehicles come into the field and what do we find? In many cases that the "talking point" of the new vehicle is a new species of drive, a different arrangement of motor or battery, or some other kink in assembling the working parts. There is nothing that is fundamentally new or superior, except in minor details, to existing apparatus; nothing which adds to greater operating efficiency. In the last analysis, the new comer is just a little "different" from vehicles already in the field.

It may be necessary for the progress of the world to let the individuality of the inventor or designer find expression, but from a cold blooded commercial standpoint, it is often wiser to let well enough alone. We cannot blame the prospective buyer of the electric for insisting on special chasses and freak bodies if these things largely obtain in the industry proper. What leaves a sting is this: every new model or design which comes out, especially where it is built just to be different from prevailing types, serves to confirm the contention of the "knocker" who claims that the electric vehicle industry is still in the development stage; that the electric truck, while showing great improvement is still an experiment—unstandardized and wanting in qualities which make for rapid adoption and national use.

The electrical industry has so many ramifications that there must be a period of development always with us with respect to apparatus designed to meet the need of some trade recently a convert to the electrical principal of propulsion or what not, but it does seem as though in the electric commercial field we might be saved from theories which are obviously wrong; from the so-called new ideas and principles which sound engineering discarded a decade ago. The pioneers in the industry have gone through all these things and have paid the price in money and in experience.

Assets vs. Liabilities

Competition among strong firms building standard vehicles based on sound engineering lines will always be an asset to the industry, especially if the product is marketed on a one-price basis, while vehicles of "talking point" design, every other one of which either has a special chassis or is sold at an introductory price, are a liability. It is a crying shame that the industry as a whole should be retarded by the blind ambition, misdirected energy or whatever is the proper mild term, of individuals who ignore the history of business in general and who really know better at heart. One can make water run up hill but 99.9875 per cent. of water will always run down hill. Why can't people take the obvious for granted occasionally and at least begin their experimenting where the other capable chap left off?

Brown & Sharpe might build a wheel barrow to sell for $50.00 but neither ball bearings nor their splendid reputation would make it a commercial success. There is no market for it. A difficult engineering feat in itself establishes nothing in a machine designed for general utility; it is simplicity which makes for economic production and economic use.

It is a mistake to assume that anything radically new is needed immediately in the electric vehicle industry. What

we need, as before stated, is production. Even refinements on existing designs can wait for production in sufficient units to reduce the initial investment to the buyer. With quantity production will come sales which will support the better adjustment of engineering details on existing designs and the development of apparatus better adopted to special needs.

Staple vs. Specialty

It is absurd to suppose that the manufacturer can afford to develop a combination ice and coal truck before he has standardized a two-ton vehicle which can be used with equal success by the wholesale grocer, the express company, the textile mill and other large users of that capacity vehicle. It isn't good business to put the specialty ahead of the staple, or even to give it the same attention until profits from wide distribution have made possible the all-round development essential to a complete line.

Did you ever go to your friend, the underwear manufacturer, and ask him to put through half a dozen special union suits for you? Had to wait about three months and pay double, didn't you? And that is only half the story. That order was only put through as a matter of friendship and it cost the mill all the way from $20.00 to $200.00 to do it. The superintendent tore his hair the minute he saw the order. The fabric in question had to be put on a spare machine at great expense. Each garment had to have red silk marking threads run through it and be watched from room to room, mixing up the miles of standard tubular fabric, "balling up" the cutting room, confusing the stitchers and causing trouble generally. You can be sure you were the most popular man for miles around all the while your specials were outside of the express office.

And the same principle is involved in building a special truck in a well regulated factory of large production. No matter what price (short of perhaps $10,000.00) was charged for it, the maker would lose money, and disrupt his manufacturing organization. The chances are, too, that as standard jigs and fixtures cannot be utilized the vehicle will suffer in high grade workmanship. Even things built by hand are not always perfect. Move the steering wheel six inches to the left and you must modify the steering mechanism. Widen the frame and about everything which supports the working parts will be short. Raise the battery box and you will need larger wheels or find it necessary to build a special "short" battery to go inside the frame and be content with a "hump" in the body. Lowering a battery normally placed above the frame would be equally expensive. Extra overhang on frame means abnormal weight on rear wheels and often 100 per cent. greater wear on tires. And so on indefinitely. Good engineering recognizes physical laws and to go against these costs money, and in a truck, decreases efficiency.

"Can't Have Your Cake and Eat It, Too"

For example, the worm drive in a 1,000-lb. wagon is a big success, but before we can have a five-ton worm driven electric truck which is a success at 7 miles per hour, we must have a greater driving reduction than has yet been produced. The worm so far shows greater efficiency at a higher speed than experience has demonstrated a five-ton electric should run to be an economic success. So there you are. Or take the speed question. In a two-ton truck one can have 15 or possibly 18 miles an hour for two hours or 9 or 10 miles per hour for up to six hours, with the same amount of "juice." One can get either high speed or unusual mileage from the one battery, but not both!

There are certain fundamental things about electric truck design, construction and operation that, let us hope, will soon be recognized by all. One of these is that standardization makes for quantity production and quantity production means a lower selling price. It is largely the special design which keeps up the price. The buyer who is willing to concede the broader general knowledge of the manufacturer as regards the relation of design to operating efficiency is doing the industry a favor and saving himself money, either on the purchase price or on the operating end. Furthermore, every standard vehicle purchased brings quantity production, with its resultant advantages, nearer to us all.

Standardization Helps Price

No, the special design is "impossible" from several standpoints. For his own protection, the live manufacturer will always add a larger motor for specially heavy requirements, but that can be done on a standard chassis. "No two vehicles alike," has done more to strew the motor truck industry with wrecks than anything else, unless it be inadequate capital. When it comes to bodies, trade practices may well be followed in general, but frills and alterations on the chassis are productive of expense, delay and dissatisfaction from the blacksmith's helper to the ultimate driver of the truck. Give us s-t-a-n-d-a-r-d-i-z-a-t-i-o-n and we'll give you the price.

Large Transformers for Toronto Power Co.

The Toronto Power Company have recently installed six 6,000 kv.a., single-phase, transformers at their Niagara Falls step-up station and six 5,500 kv.a. similar single-phase units at their Toronto terminal station. This installation is of special interest in view of the fact that the new transformers were especially designed and constructed to fit the existing transformer pockets which were laid out originally for lower voltage units of less than half the present capacity. The original transformers were single-phase, water-cooled, units designed for 2,670 kv.a., 60,000 volts, at the generating station and for 2,400 kv.a., 55,000 volts at the terminal station. These transformers were of the familiar oval type. The new transformers are single-phase, water-cooled units of 6,000 kv.a. unit capacity at the Niagara Station, designed for 86,500 volts and similar units of 5,500 kv.a. each at the Toronto terminal station designed for 76,100 volts.

They were built by the Canadian General Electric Company at their Peterboro factory and are assembled in square or slightly rectangular boiler plate tanks, having all seams oxy-acetylene welded. The flat sides of the tanks are braced by "T" iron straps for mechanical stability. The transformer tanks were required to stand a 26-in. vacuum test at the factory before acceptance. The usual heavy castings have been replaced in this design by channel core plates rivetted together in pairs. A space is left between the channels which is arranged to come directly over a vertical duct in the iron, allowing a free circulation of oil up through the centre of the iron. These features and others which it is understood have been adopted as standard by the manufacturers of these transformers account for the remarkable increase in capacity per unit space over the original transformers in the same stations. The same factors are reflected in the gradual tendency toward smaller dimensions and lighter weights in power transformers making use of rolled steel instead of heavy castings.

A Surplus in Every Case

The semi-annual report of the operation of towns and cities, included in the hydro-electric system, for the first six months of 1914 shows surpluses in every case. A number of reductions will result. The city of Galt, with an average monthly surplus of over $1,000, gets a 16 per cent. reduction which brings the domestic rate to about 2½c. Other towns are eager for reductions and it is expected a number will be granted. Toronto's rates have not yet been finally determined.

Practical Operation of Suspension Insulators

Simplest Design of Insulator Advocated—Troubles with Short Circuits—Draw the Line Up Tight—The Use of Auxiliary Weights

By H. W. Buck*

The application of suspension insulators to high-voltage transmission lines, since their first introduction in 1905, has been very general on all lines operating at voltages over 50,000, and the results obtained have been in most cases very satisfactory. The change, however, from the rigid pin insulator to a construction involving the free and flexible suspension of the conductor in space is a radical one and the change in practice has taken place with considerable abruptness, so that it is not surprising to have experienced a new class of line troubles. It is the purpose of this paper to point out a few of the difficulties which have been experienced, with the hope that a discussion of the subject may lead to improved standards of construction for such lines.

In the pin insulator line the conductor is held rigidly at every insulator, consequently lateral and longitudinal movement of the conductor is resisted at every point of support. Suspension insulators, however, except at dead-end connections, are free to move in all directions. The result is that high winds occasionally cause displacements which are electrically and mechanically dangerous to the operation of the line. Deflections of suspension insulators from the vertical position result also from other causes, which will be discussed later.

Large angular deflections of suspension insulators require large clearance spaces, which necessitate long cross-arms and increased cost of tower. Consequently it is desirable to limit the deflection as far as possible. A 60 deg. angle from the vertical is assumed to be the maximum allowable under extreme conditions.

In order to show how nearly the above limitation can be attained in practise Table I. is given, indicating the deflections caused by wind pressure on various sizes of conductor, at the insulator. The wind pressure assumed in the table is 15 lbs. per sq. ft. of projected conductor area, which is taken as the maximum. Wind pressure deflections are practically independent of span length, since wind pressure per span and the force which resists the wind pressure, namely, the weight of the conductor, both vary directly with length, in the same proportion.

Table I.

A Size conductor	B Wind pressure	C Angular deflection	D Auxiliary weight
Stranded Copper			
4	15 lb.	66 deg.	0.041 lb.
3	15 "	63 "	0.028 "
2	15 "	60 "	0.0 "
1	15 "	58 "	0.0 "
0	15 "	55 "	0.0 "
00	15 "	52 "	0.0 "
000	15 "	49 "	0.0 "
0000	15 "	45 "	0.0 "
Stranded Aluminum			
2	15 lb.	81 deg.	0.156 lb.
1	15 "	79 "	0.161 "
0	15 "	78 "	0.171 "
00	15 "	77 "	0.182 "
000	15 "	75 "	0.186 "
0000	15 "	74 "	0.196 "
250000	15 "	72 "	0.190 "
300000	15 "	71 "	0.177 "
400000	15 "	68 "	0.158 "
500000	15 "	66 "	0.125 "

*Read before the A.I.E.E.

Experiments have shown that the weight of the string of suspension insulators themselves will not act to resist wind displacement of conductor, since the exposed surface of the insulators is sufficient to cause their deflection by wind pressure without the attachment of the conductor. Neither will the deflection vary appreciably with the size and design of the insulators, since a heavier insulator ordinarily exposes a larger "sail area." The wind displacement of conductor can therefore be assumed to be independent of the number of insulators in the string, and of their particular design.

Table I. indicates approximately the wind deflections which will take place for various sizes of conductor under a stress of wind equal to 15 lbs. per sq. ft., as above. Two tabulations are given, one for copper, and the other for aluminum.

In Table I., column A shows the conductor size in B. & S. gage. Column B gives the assumed wind pressure in pounds per square foot of projected cable area. Column C gives the angular deflection of the insulator from the vertical, due to the assumed wind pressure on the conductor, assuming that the insulator itself deflects independently and neither increases nor decreases the displacement of the conductor. Column D shows the amount by which the weight of the conductor would have to be increased in order to reduce the deflection of the insulator under the assumed conditions to within the 60 deg. limit.

It will be seen from an inspection of the table that all sizes of copper except the smallest sizes listed, namely, No. 4 and No. 3, will ballast the insulators sufficiently to keep the wind deflection down to within 60 deg. A line of No. 4 B. and S. wire, it will be noted, is deficient in weight to the extent of 0.041 lbs. per ft. and No. 3, 0.028 lbs. per foot.

On the other hand, all the sizes of aluminum cable listed will allow deflections in excess of 60 deg., and especially among the smaller sizes, objectionable displacements will occur. Under these conditions one of the chief supposed advantages of aluminum, namely, its lightness, becomes its disadvantage, and the actual ballasting quality of copper due to its higher specific gravity and smaller size is a distinct advantage.

The larger sizes of conductor are more stable mechanically against wind deflection, since their weight in proportion to the surface exposed to wind is greater than in the small sizes, the weight increasing as the square of the diameter, whereas the wind pressure is only directly proportional to the diameter.

Weighting the Line

Fig. 1 shows a method for reducing deflection which has been adopted on an aluminum transmission line in the South, about 200 miles in length, which has produced satisfactory results. The line is of No. 0 B. & S. aluminum cable, with an average span length of about 300 ft. An auxiliary weight made of cast iron is attached to the lower side of the suspension clamp at every insulator. It is consequently placed at a point where it is most effective as ballast. This arrangement results in very satisfactory stability of the line under all conditions.

Column D, Table I, shows the auxiliary weight which

must be added at each insulator for the proper stability, expressed in pounds per foot of span. In the opinion of the writer, auxiliary weights of this kind should be provided on all aluminum lines using suspension insulators and on all lines where the smaller sizes of copper are installed. The auxiliary weight not only stabilizes the line against wind pressure but improves its operation in many ways, such as in resisting longitudinal movement of insulators under unbalanced pull due to a breakage somewhere along the line. It also improves conditions where a gust of wind strikes a single span independently, in reducing the slack which can be taken from adjacent spans due to unbalanced pressure.

A curious and unusual phenomenon has been experienced on at least one suspension insulator transmission line known to the writer. A severe sleet storm had occurred

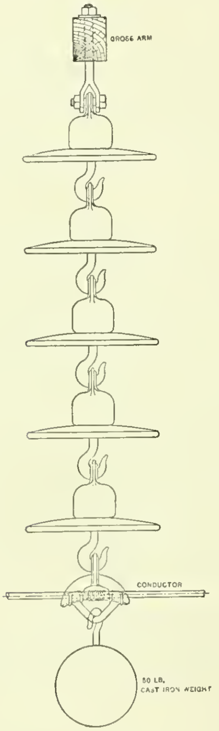


Fig. 1.

along the line during the night and all the conductors were covered with a heavy coating of sleet. When the sun came out in the morning the sleet started to melt, but it did not, naturally, fall off all spans of the conductors simultaneously. One span held the sleet longer than the rest in its neighborhood with the result that it sagged (taking the slack from adjacent spans) and came in contact with the conductor below, causing a short circuit. Such a combination of circumstances, although unusual, might happen on any suspension insulator line where the conductors are disposed in the vertical plane, and should be guarded against.

On long tangents on a suspension insulator line where there are no dead-end connections installed, if a very high wind strikes the line at an angle of about 45 deg. cumulative waves like the waves on the surface of the water have been observed to travel along the conductors of the line, causing a whipping action at all suspension insulators, the waves finally "breaking" as on a beach at the first dead-end connection met. This phenomenon cannot occur on a pin insulator line, since the line is confined at every crossarm. This trouble can be prevented by dead-ending the line at frequent intervals.

The methods of dead-ending suspension insulator lines as at present practised cannot be considered satisfactory. There is a wide margin for improvement in the design of the mechanical fittings used for the purpose, especially in providing means for preventing the lateral swing of the jumper connection. Here, too, some form of ballast weight might be used to advantage.

In the experience of the writer the suspension insulator units which have given by far the best service over a long period of time are those of the simple general form shown in the assembly in Fig. 1. The design of these discs is entirely free from corrugations, flanges, petticoats, etc. While such devices increase the resistance of the insualtor to surface leakage and surface arcing, the complexity of form seems to introduce internal shrinkage stresses in the process of moulding, firing and cooling, which in time, due to sudden temperature change or mechanical shock, will develop into puncturable faults. The insulator of simpler form is cheaper and more can be installed in series at the same cost and with the same electrical factor of safety as with a fewer number of discs of a more elaborate and expensive design.

Insulator Precautions

In general, most of the troubles which are being experienced in the various suspension insulator lines built to date can be overcome by the following precautions.

1. Provide liberal clearance between conductors and between conductors and supports. This should be considerably more than good practice would require in a pin type insulator line.

2. Install the lightning ground wire, if used, high above the conductors, so that no combination of gusts of wind can whip the conductor into it when suspension insulators are deflected to the maximum angle.

3. Place auxiliary ballast weights at every suspension insulator where aluminum cable is used and with the smaller sizes of copper.

4. Design the jumpers and fittings at the head-end connections so that the jumpers cannot possibly become displaced and come into contact with the crossarm.

5. Draw the conductor up tight throughout the line. A too conservative allowance of slack to guard against possible mechanical stresses in the conductor will cause more trouble than it will prevent.

The insulating properties of suspension insulators have proved adequate for all line voltages so far attempted up to 150,000 volts, and the satisfactory results have been attained within reasonable mechanical dimensions of insulators. The insulating units shown in Fig. 1, which are about as small as any made, electrically or mechanically, being merely 10-in. disks of plain surface, will arc over "dry" at about 80,000 volts and "wet" at about 50,000 volts. The arc-over voltage is well under the puncture voltage. Insulating units of more elaborate design will withstand considerably higher voltage tests. Mechanically, such insulators will withstand tension stresses of at least 5,000 lbs.

In determining the proper number of disks to be strung in series it is advisable to install the number required for the desired factor of safety and then to add at least one disk for reserve against breakage. In other words, the insulator should have a sufficient number of disks in series so that in case one or more are broken or punctured the remaining intact disks will afford a sufficient margin of insulation for

safe operation until such time as the broken disks can be replaced.

On this basis, assuming an insulation factor of safety of two, an 80,000-volt line would require four of the disks of Fig. 1, 100,000 volts, five disks, and so on for higher voltages. These results are interesting for comparison with the probable cost, mechanical dimensions and strength of a pin insulator which might give equivalent results.

DISCUSSION

The following extracts from the discussion which followed have special practical bearing on the subject:

H. W. Buck: I want to corrobate what has been said in regard to the sag table. It is one of those engineering problems which are worked out in the office in accordance with certain theoretical laws which are apt to be more or less disregarded in the field. There are many such phases in engineering, and there are some good reasons for disregarding the exact science of such deductions in field work. A sag table is worked out usually for level country, with a few cases given as exceptions to apply to certain typical points on the line where the profile varies from level. With a line crew out in the mountains under severe stress of weather, working as best they may, possibly at low temperature and with high winds, it is absolutely impossible to get construction men to pay attention to such refinements as are usually given in sag table calculations.

The point of this is that we should not rely too much on theoretical data of this sort. We should give our instructions in such form and should make our designs with sufficient margin so that results can come within the scope of action of the average construction crew, and not make the operating success of a transmission line dependent upon the fulfilment of all the exact theory exemplified in a sag table.

Charles E. Waddell: A point brought out by Mr. Buck is the question of line ballasting and the effect of swinging of insulators. It seems to me that it is desirable to suspend the insulators so that they have infinite latitude to swing with the line, making a hinge for that purpose, but that the movements across the line be restricted to the lost motion in the joints themselves.

With a wind blowing across the line, the swinging is restricted to the individual span,—the line as a whole is not deflected outward. This prevents a wave starting that may ultimately end in the line rotating, with the result in some cases of wrapping the conductor around the ground wire.

I heartily agree with Mr. Buck as to the wisdom of using a number of small, single piece, inexpensive disk insulators. I believe these are to be preferred to the use of the two-part insulator with its greater surface and greater first cost.

I cannot say that I agree with Mr. Buck on the subject of ballasting the line, however. It seems to me it might be a very excellent desideratum where some emergency condition had to be met, but in designing new work I think that a lower voltage and larger wire, a more carefully graded line, and closer tower or pole spacing, would meet the same needs without introducing the added weight on structures and stresses on the insulators.

R. J. McClelland: Taking up the question of the arrangement of conductors, with regard to the "staggering" of conductors in vertical arrangement, it would be interesting to learn from the engineers who have used the extended middle arm construction if this has given the desired freedom from "sleet-jump" troubles. Has it been proved that 2 to 3 ft. horizontal offset in a span of over 1,000 feet gives satisfactory operating conditions at voltages of 60 kv. and over?

For protection against severe wind conditions only, the vertical arrangement of conductors is the better, whereas the horizontal arrangement of conductors is better for protection against sleet troubles.

In some recent 110 kv. construction, an interesting expedient has been used to guard against excessive sag produced in one span due to unequal distribution of sleet over the adjacent spans. At every third or fourth suspension tower a special "semi-tension" insulator construction is used; that is, instead of one single string of insulators in suspension which allows the conductor to move in the direction of the line, as much as 14-in. in the case of extreme uneven sleet load, two strings have been used, attached to the tower at an angle of 45 deg. like an inverted V. Under normal conditions a tower with this construction is practically a suspension tower, and the conductor runs straight through without a sudden change in direction, such as occurs at a tower equipped with tension insulators and a jumper; but whenever unequal sleet loading takes place, the tendency of the heavily loaded span is to rob the adjacent spans of their sag and this is opposed by one of the "semi-tension" strings acting more as a tension insulator. I understand that sandbag loading tests have indicated this construction to be effective and the application of this idea might prove of benefit for existing lines in the heavy sleet territories. This installation will be watched with interest.

It may be noted that I have used the term "tension insulator" in place of the usual "strain insulator" as the former designation would seem more closely descriptive of the actual working conditions of the insulator.

Concerning transmission line hardware for all heavy service I have found it desirable to eliminate all malleable cast iron hardware, and it would be well if structural or pressed steel fittings, or mild steel castings, were developed for this service, on account of the increased reliability that would be obtained thereby.

On certain double-circuit tower line construction our company has equipped both suspension and tension clamps of all insulator strings of one circuit with discharge horns, leaving the other circuit with discharge horns on tension clamps only. It will be interesting to compare the performance of these two circuits in service.

V. Karapetoff: I wish to take exception to statement No. 5 in Mr. Buck's paper, where he says "Draw the conductor up tight throughout the line. A too conservative allowance of slack to guard against possible mechanical stresess in the conductor will cause more trouble than it will prevent." I am afraid this statement, coming from such an authority as Mr. Buck is, will cause us more trouble than it will prevent. Several cases came to my attention not long ago where considerable trouble was caused by the conductor being drawn too tight, without reference to the stresses in the winter or during high winds. By interviewing the line superintendents, I found out that it is difficult to force the construction gangs and the foreman to conform to the tables of sags and also to use the dynamometer where the sag is determined by sighting the line. I wish very much that Mr. Buck would modify his statement so as to remove the impression that he does not believe at all in the correct calcualtion of sags and stresses, but simply advises us to draw up the lines as tight as possible.

P. M. Lincoln: I would like to make a statement in regard to the point just raised by Mr. Karapetoff. I am inclined to believe that Mr. Buck is quite correct in the way he puts it. I do not believe that any great difficulties are to be anticipated from drawing lines too tight. I think the tendency is in the other direction—to allow them to become too loose. If a line is put up too tight and cold weather comes along, it may possibly strain the material of the line above the elactic limit, but what is going to happen if it does? It simply stretches a little, and when the warm

weather comes along the stretch will result in a little more sag than before; but to stretch the material of the line above the elastic limit is not necessarily going to hurt the material. The material, in the course of its manufacture, has been strained above its elastic limit continuously, and if it is strained above the classic limit after it is in service it is not by any means fatal to the line.

Julian C. Smith: There is one point in Mr. Buck's paper to which I take exception, and that is the number of units which would be put on very important transmission lines. It seems to me that the number of units should be fixed by the climatic conditions or local conditions rather than the operating voltage.

E. M. Hewlett: Mr. Buck has explained that if an insulator is designed with a petticoat so short that the flash-over point is much lower than the puncture point, normally, under both dry and wet conditions, the insulator will be less severely strained and will not be subject to as rapid deterioration as has been shown by some of the insulators used now. A number of the recent insulators have too great a diameter of petticoat, so the flash over is too close to the puncture voltage.

Then, again, if you insulate your line for lightning conditions, as suggested by one of the last speakers, it will also be necessary to protect or insulate the transformers, lightning arresters, switches and everything else for the same conditions. This is a most important consideration.

Also, in the matter of mechanical strength, the distortion in design of the insulator to give great strength often works against the electrical characteristics. You thus handicap yourself when you ask for strength greater than is required.

H. W. Buck: I am glad that Dr. Karapetoff has raised the question covered by paragraph 5 in the conclusions at the end of my paper, for it offers an opportunity to accentuate the point which I desired to cover in this paragraph. Most transmission lines are too slack and during the past year reports have come in from all parts of the country giving instances of short circuits resulting from conductors swinging together under wind stress, even where liberal clearances were allowed between conductors.

It has been customary to assume a heavy loading of sleet and the simultaneous action of wind velocities up to 100 miles per hour, allowing slack for these conditions, and then in addition to throw in a little for good luck. On top of all this slack, after the line has been in service for a few months the natural stretch which takes place in all conductor materials before a condition of permanent set has been accomplished, still further increases the sag of the spans. The result of this is that many transmission lines are a series of festoons between tower supports, with all the lack of inherent stability which such a condition gives rise to.

I cannot see any reason for modifying this statement in regard to drawing the wires up tight, unless by supplementing it with a statement that the towers must be made strong enough to withstand the strain. The first line of the paragraph in question should of course be read in connection with the following three lines, which qualify it, I believe, sufficiently.

Municipalization of Hydro Electric Power

In Sherbrooke, Quebec—An Exhaustive Paper Read Before the 14th Annual Convention of the Union of Canadian Municipalities

By B. A Dugal*

I have attended, in the past few years, several conventions of electricians, and have read in the papers and in the electrical magazines about everything that has been written on the municipalization of electricity, for and against. I never met, at conventions, electricians who were connected with private corporations, that were in favor of municipally owned plants. It is so very easy to find out why they are opposed to municipal plants, that I do not even need to mention it here.

A short time ago an American magazine gave a list of some thirty or forty municipal plants in the United States that were not a success, and went to the wall. I am not conversant with the local conditions where these plants were situated, and cannot account for their failure, but I will simply try, in answer to that, to give you the history of our Sherbrooke Municipal Plant and its success.

An electric municipal plant to be successful must generate its power by hydraulic power. Steam generated plants are very expensive, and it is figured up by engineers that it costs from $20.00 to $25.00 per year to generate one-horse power before you can get that horse power to do any work. A municipal plant must not have very long transmission lines to carry the current from the generating station to the customer. Transmission lines are both costly in initial cost and also in maintenance cost. Another point where municipal plants failed is where a large amount of power was developed and only about 40 or 50 per cent of said power was required by the local conditions and customers. In a case like that the fixed charges are on the total of power developed while the revenue is only on the power sold, and unless a fairly good profit is realized, which means pretty high rates, both ends cannot be met.

I would like to mention here one drawback about municipal plants, which in our case, we have to suffer very often. When the Cities' and Towns' Act of the Province of Quebec was made and revised, there was no municipality in the Province which had municipalized public utilities, as an electric plant, and the different clauses of the Cities' and Towns' Act were not made, in a business-like way to govern any trade or commerce of that kind. After all, municipalizing and selling electricity is a commerce and industry like any other kind. We should be put on the same basis as all the other private corporations, in the same business. It takes us one or two months before we can make any important move. In our case, the electric department committee has first to study the question. It has then to be reported to the council at its first meeting. If it is a case of new expenditure, it will have to be referred to the finance committee. The finance committee will then report to the council. Again another resolution has to be passed by the council authorizing the officials to ask for tenders. The tenders will come in ten or fifteen days afterwards, and it takes another report from the committee to accept one, and before the department can give the order for the goods, one or two months have passed, and of course there are only twelve months in the year. If the expenditure asked for is to be paid out of borrowed money and has to be referred to a public vote, it

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means another month and a half delay. Representation should be made to the Quebec government that a special act should be made to govern and rule municipal plants. We have a Public Utility Commission and I do not know that they are so busy that they could not have time to look after us. Another drawback is the obligation we are under to buy everything by tender. In our business, almost every line of it is combined and the demand of tender for a certain line of goods with its ten or fifteen days grace, gives plenty of time to all trusts and combines of this country and of the United States to communicate with each other and all quote the same price, which means of course, in many cases a high price. I can prove that we can buy goods in many cases at much lower prices without tenders. Another drawback for a municipal plant is not to be able to sell electrically heated devices to promote in the sale of current. I do not know of a firm engaged in the sale of electricity which has not a new business department where all kinds of electrically heated devices are sold at a fair profit, but at the same time at a price which can be reached by the customer. Take our case here in Sherbrooke. We sell and claim to be giving to our customers about the lowest, if not the lowest rates for power, lighting or heating. I will give you these rates later on. Still the Cities' and Towns' Act forbids us to sell goods. We sold some at a profit from 20 to 30 per cent except in one case where we sold at 10 per cent. profit to promote our new rate for heating and cooking, which is only .02 cents per kw. hour. But the local merchants objected. They discovered, that in virtue of the Cities' and Towns' Act, we could not do it, and a protest was served on us and we had to stop selling.

At the last convention of electricians held in Montreal this summer, Mr. W. B. Johnston of Montreal, in a paper which he read says: "Prices should be maintained from 20 to 30 per cent above cost. Sale of appliances should not however be left entirely to dealers, as such sales are also boosted by the central station carrying them."

A Study of Retail Prices

Relying on that, let us study the retail prices of some of the electrically heated devices sold by dealers in Sherbrooke. A Munderloh, C. G. E., Northern Electric, National or Hotpoint sad iron which costs from $2.75 to $3.00 f.o.b. Sherbrooke, is sold at $4.00 and $5.00. A Hotpoint el glostovo stove costs $3.00 f.o.b. Sherbrooke, it is sold at $6.00. I could give you a complete list of apparatus and you will find the same thing. You can verify these figures by going into the store selling this apparatus. The same thing exists for electric lamps. The best wire drawn filament tungsten lamp can be bought to-day from 22 cents to 28 cents; we used to sell them at 40 cents but the dealers wanted to get 50 from the consumers. I cannot call that a reasonable profit.

Our population of Sherbrooke is composed of about 20 to 25 per cent who are getting in revenue or salary from $1,000.00 a year or more, the balance is composed of laborers, workmen, mechanics or clerks who are earning from $500.00 to $1,000.00 a year. If some eight or ten dealers have to be protected in their business, I should say that there are 20,000 people, who are consumers of electricity, that are also entitled to be protected.

Municipalization of electricity was won in Sherbrooke, after several years of very hard fight, and after having been defeated twice by the people. The old Electric & Gas Company, would not be municipalized, and the city council, under the lead of Ex-Aldermen McManamy, Thompson, Olivier and others, bought the Westbury Basin Power which was called a "Gold Brick" at that time, and for which the city could get three times what it cost, to-day, to start a municipal electric plant.

Steps were also taken to buy from the local government, a part of the bed of the Magog River. The old company came to terms, and on the 1st of May, 1908, the city bought it out and paid the sum of $250,000; an issue of bonds was made for $170,000, and the old company's bonds, amounting to $80,000, were assumed by the city. The purchase of the Magog River bed gave place to the famous suit between the British American Land Company and the city. It would be too long to give you the details of this, but in 1910 the whole question was settled "a l'amiable" and we bought all the pretended rights of the British American Land Company on the same part of the river. In 1911 as the demand for power was increasing very fast, we developed the "Drop Off Power" on that part of the Magog River. By doing this, we accomplished our dreams of being able to use the full flow of the Magog River twice, once at the "Drop Off" and again at our city plant right in the heart of the city.

Our plants are up-to-date and everything is kept up to the standard. The longest interruption of current for the past three years has not exceeded five minutes, and even then I do not believe it has taken place more than two or three times in three years. Of course on Sunday mornings, the current is turned off for repairs and cleaning up.

In 1908 the rates of power and lighting were as follows: Power from $25.00 to $45.00 per horse power; for lighting 10 cents per kw.hour. To-day the rate for power is ¾ cent per kw. hour with a minimum bill of so much per h.p. per month on the total installation of motors. This minimum bill being from $1.00 down to forty cents, according to the class the customer is in. The rate for lighting is 6 cents per kw. hour less 10 per cent discount. Window and sign lighting is sold under the flat rate of $1.50 per 50 watts per year. Current for heating is sold at 2 cents per kw. hour, the customer can use that rate for anything he wants except lighting.

In 1908 we had 1,980 accounts; we have now 5,139. This is an increase of 259 per cent. The revenue of 1908 was $72,214.62; this year it will be about $135,000.00. The assets of the department in 1908 were $351,365.96; on the first of July last they were $740,874.14. The profit and loss account stood at $98,652.26 in 1908; on the 31st December last it was $203,406.92.

In 1908 we had for street lighting, a system of ninety-five old style arc lamps and a few dozen 32 c.p. carbon lamps. To-day we have over 1,400 high efficiency tungsten lamps, many of them being of the latest type, the nitrogen gas filled lamp, which affects a saving of current of 60 per cent on the wire drawn tungsten lamp.

In 1908 we had 1,036,000 ft. of distributing lines. We have to-day 1,527,280 ft. In 1908 we had three generating units with a capacity of about 2,000 h.p. We have to-day five units in two stations with a total generating capacity of 4,600 h.p. In 1908 we did not control a water storage. To-day we control one foot of water on the Memphremagog Lake which is 32 miles long, and from one to two miles wide, and five feet of water on the Magog Lake which is 7½ miles long and one mile wide. We have at the present time enough water stored in the two lakes to keep our two stations running full blast for sixty days if not a drop of water was to come to these lakes. This is our "White Coal." How much would it cost in coal to do the same work that this water can do?

The valuation roll of 1913 shows that there are in Sherbrooke 3,953 residences, tenements, offices, warehouses, shops, factories, etc. On the 1st of July we had 3,756 of them connected with our lines, leaving a little less than 200 not connected. Not many cities can show the same thing.

Our connected load in 1908 was about 3,000 h.p. It is to-day over 8,000 h.p.

Following I will give you some more figures in dollars and cents about our revenue and expenditure of 1913:

Electric Revenue 1913

Total from all sources	$101,989.11
or $22.66 for every h.p. we can generate (4,500 h.p.)	

Electric Expenses 1913

Our fixed charges, including insurance, taxes, interest on bonds, amounted to $34,324.02 or for every h.p.	7.62
Our operating expenses were $6,405.96 or for every h.p.	1.42
Our maintenance expenses were $23,494.59 or for every h.p.	5.22
Our administration expenses were $9,328.04 or for every h.p.	2.07
Making a total production cost per h.p. of total generating capacity of	16.33
This left a net profit per h.p. of	6.33
4,500 h.p. at $6.33 profit equal	28,485.00
Our books and annual statement of 1913 show a surplus of	27,941.01
Our recording instruments show that in 1913 we generate 5,100,000 kw. at a cost of $42,405.54 not counting the interest and depreciation charges, or at an average cost per kw. of ..	.00,831 ct.
Our electric revenue for 1913 was $101,989.11 or an average revenue per kw. of	.01,999 ct.
Leaving a net profit per kw. of	.01,168 ct.
5,100,000 kw. generated at .01,168 ct. profit per kw. would amount to	$59,568.00
Our books and annual statement for 1913 show a profit of revenue over, operating maintenance, administration expenses of	$59,583.57

These two statements show clearly that our municipal plant, although being worked along on low rates for power and lighting, is making good and is a success. It also shows that our profit is a real one and not one made on paper to attract stock subscription, or to boom shares on the market, as is very often done. To the most pessimistic ones, the ones that only dollars and cents will convince, I will say that on the first of July last our liquid assets were composed of:

Cash in hand	$33,409.75
City of Sherbrooke bonds on hand bought from the city	75,000.00
Total	$108,409.75

This little paper was not intended to boast of ourselves. All the citizens of Sherbrooke are proud of owning so many public utilities, especially electricity. If any municipal plants were not successful, ours has been, and we hope that our success will induce many of the delegates at this convention to start a campaign in their own town, to municipalize public utilities, and have the ratepayers derive the benefit.

The beauty of municipalization of electricity is that there are no combines or trusts to make a ruinous competition, and all the profit instead of being paid in dividends to shareholders can be paid to the real shareholders who are our consumers, by giving low rates and good service.

British Columbia Telephone Betterments

Innovations, extensions and improvements have been features of the policy of the British Columbia Telephone Company during the past few weeks. This company has its head office in Vancouver and is a provincial concern altogether, and the progress it is making is a creditable commendation to home management. Within the past week it has announced a reduction in long distance telephone rates (affecting adjacent exchanges) of from 40 to 60 per cent; a special night rate for long distance, giving three times the length of a day conversation for the regular day rate between 7 p.m. and 8 a.m., and the institution of continuous service in all its exchanges, numbering thirty-nine throughout the province. No other company in the world gives continuous service over all its system. The larger cities need it, but in the small country exchanges, where the calls might not exceed one or two a night, the closing hour has been 10 o'clock.

The institution of these changes is in line with the policy of the B. C. Telephone Company to give the best service all the time. To do this it has completed an elaborate scheme of construction, supplemented with complete and the most up-to-date inside equipment. It has brought into intercommunication all its exchanges on the lower mainland and Vancouver Island, and also the interior exchanges. The company operates exchanges in the Slocan, Kootenay and Boundary districts, and owing to the nature of the country there a certain amount of isolation has existed. Acting in co-operation with the C. P. R. and Dominion governments, these interior exchanges are now within talking reach of each other, and it is only a matter of time before they will be in touch with the coast. The consummation of such a policy will make inter-provincial interests more mutual, will build up communities and result in British Columbia getting the full benefit of its own development.

To link up the various sections, connection with the Grand Forks exchange of the company was made with the provincial government line, which runs forty miles up the north fork of the Kettle river and is primarily intended for forestry purposes. Many settlers live along this valley. W. H. Beach had a line from Christina Lake to Cascade, and this has also been connected with the company's system, so that all the available telephone facilities are now within reach of all the people along these routes.

During the past few months the engineers of the company have been busy bettering transmission and making other improvements, the cost of which has been very considerable. Extensive relief work has been carried out or is in hand in Victoria to give service to new subscribers. Extensions have been made of the cable out of the Nelson exchange along the Hall Mines road. Reconstruction of the company's plant along the Chilliwack line of the B. C. Electric has been started. Because of the high tension wires in that locality underground cable is being put in at the crossings for the local lines, while all toll crossings are being standardized. The lead along Canoe Pass road, near Ladner, has been repoled and is now in excellent condition. An extensive estimate is in hand for North Kamloops, where telephone service will be extended to Fruitlands.

The B. C. Telephone Company also expects to have two more exchanges in operation shortly, one at West Vancouver on the north shore of Burrard Inlet, and the other at Colquitz, just out of Victoria on Vancouver Island.

An instance of what betterment is being made is in the great reduction of trouble on subscribers' lines in Vancouver. In the past three years the increase of subscribers has been 109 per cent, while during the same period the decrease of trouble has been 71 per cent, a record that is difficult to surpass.

Another important private branch exchange is that signed up for the Hudson's Bay Company's new store. This will have an order board in connection, the first to be installed by a large commercial concern north of San Francisco.

The new telephone toll of copper, 24 wires in the initial construction, between Vancouver and New Westminster is about completed.

Electric Railways

Direct-Current Distribution for Surface Railways —Urban Service

By R. H. Rice

[A sub-committee on Distribution of Electric Energy was recently appointed by the American Institute of Electrical Engineers and a number of the more important problems in distribution have since been treated before the Association by members of the committee who have had particular experience in these problems. The following report on "Direct-Current Distribution for City Surface Railway Systems," by Mr. R. H. Rice, indicates the best and most economical practice to date].

Electric railways very frequently have energy furnished to them over high-tension, alternating-current transmission lines, and in this section of the report the sub-stations are included in the distribution system. The component parts of the distribution system for urban street railway service are then:

1. The converting equipment in the sub-station;

2. The positive system from the sub-station switchboard to the car, including feeders and trolley wires;

3. The negative system or returns, which complete the electric circuit from the car to the sub-station negative bus and include the electrical features of the track.

The usual city street railway system is characterized by having rather short feeding distances, large and rapidly fluctuating loads, and a wide variation in energy requirements at different hours of the day. Public demand is increasingly insistent upon quick and adequate service, better light and more heat, and this requires a greater amount of energy to be cared for in the distribution system, and greater reliability in its operation.

Sub-Station Equipment

Sub-station equipment has become quite standardized and various installations differ chiefly in arrangement and in minor details. The equipment in a modern sub-station is housed in a well-lighted and ventilated building constructed for this purpose. It should be so arranged as to leave ample space for making repairs, and for installing or removing parts as may be necessary. A travelling crane is usually provided to facilitate such changes, but is now frequently omitted as the standard modern machinery is so reliable that it is rarely necessary to make replacements of parts requiring the use of a crane. Not only is there a saving in the investment for a crane but the building may be made lower and the side walls somewhat lighter, thus making an additional saving. Frequently no heating plant is installed as the waste heat energy from the machines is sufficient to give a comfortable working temperature.

The supply of energy to a sub-station is almost universally from three-phase high-tension lines, and for railways is of 25 cycles. For city service such high-tension lines should be, and usually are, underground to ensure more reliable service and to prevent danger to the public by exposure to high voltage. Conversion to direct-current in the sub-stations is by the universally accepted machine, the synchronous converter. It is desirable to have a separate high-tension line to serve each converter when the machines are of large capacity, and used in important city service. Switching arrangements are made to use any converter with any incoming line, so while the normal operation on the alternating-current side is by independent units of high-tension line, transformers, converters and other apparatus, emergency connections may be made as desired to interconnect the units. On the direct-current side the converters are operated in parallel, being connected to common positive and negative buses.

The synchronous converters used for railway purposes are 600 volt direct-current, compound-wound, and the later machines have commutating poles. Just a few years ago a 2,000 kw. unit was the limit in size, but 4,000 kw. machines are now in service. The cost of these large machines is less per kilowatt and they occupy but little more space in the sub-station, making the area per kilowatt much less than formerly. It is possible to place a 4,000 kw. machine on the same foundations formerly occupied by a 2,000 kw. unit. Care in design has made this improvement possible, and the later machines contain numerous refinements in design which in the aggregate improve this class of machine very materially.

Switching is performed by motor or solenoid-operated oil switches controlled from the main switchboard, and energized from a low-potential storage battery circuit. This battery circuit also provides current for the switchboard and station emergency lights.

An effort is made to keep the power factor of each station unit as near 100 per cent. as possible. The rotary shunt field and the reactance are so adjusted that with a given high-tension line voltage and direct-current voltage the converters will operate with 100 per cent. power factor when fully loaded. If the converters are operated under overload conditions there will then be a leading power factor, and if operated under less than full load there will be a lagging power factor. Most railway sub-stations can operate very near to 100 per cent., and this is usually desirable when energy is purchased from a central station company. In some cases a penalty is attached, in the way of increased power cost, when the power factor deviates from 100 per cent.

The Positive Feeder System

There is not much variation in practise among companies in positive feeder distribution. In general the trolley line is sectionalized by line breakers or section insulators, placed as desired, and each section is fed from a separate feeder panel in the sub-station. This feeder is very often composed of several cables running by different routes and tapping in at different points to a distributing cable running along the street, from which feed taps are made to the trolley wire. The above "radial" system of distribution is not so economical of copper as a "network" system in which all of the trolley wires form a continuous network and the

feeders furnish energy to selected points of the network. As the load shifts from point to point all of the trolley wires and distributing cables act as equalizers and feed current to the point needed. It is difficult to locate trouble in an extensive network of this kind and also difficult to isolate the portion in which the trouble occurs, so that this method is not in common use. Some effort has been made to utilize the advantages of a network with the radial system by joining adjacent trolley sections through fuses or circuit breakers. Such a method has not been found satisfactory because it was impossible to adjust the connection so that it would distinguish between a heavy transfer of current from one section to another due to shift of load, which it should allow, and a heavy flow of current into a section due to short circuit, which it was not intended to permit. As a result these section connections usually became so unreliable that they could not be depended upon and were abandoned. A common practise at present is to provide knife switches, mounted in a pole box, which are normally open, but which may be closed on each end of a section if for any reason the feeders to this section become disabled. Such a plan provides a quickly operative and convenient device for ensuring continuity of service, as it is quite unlikely that the two sections adjacent to a disabled section would also be out of service.

Feeders Underground or Overhead

The feeders may be underground or overhead. In the largest cities, and in many of the smaller ones, the municipalities require underground distribution at least in the central business district. The underground cables are installed in tile ducts and at frequent intervals lateral connections are made between these cables and the trolley wire overhead. A typical lateral connection consists of a tile duct, or fibre-lined iron pipe, running from a manhole to an adjacent trolley pole, and connecting with a vertical fibre-lined pipe clamped to the pole. This vertical pipe should be at least 10 ft. high, and just above its upper end a switch box and lightning arrester are attached to the pole by means of brackets. The lateral underground cable is run from the manhole to and up the pole and connected to the switch. Between the top of the pipe and the switch the cable should be stripped of its lead sheath, taped and painted with an insulating paint, and the top of the pipe should be capped with a split wood plug which is cored to fit the size of the cable used in the lateral. This should be done to keep snow and rain out of the pipe.

The lightning arrester is attached to the riser from the switchbox and the ground wire passes down through the pipe to a ground rod in the floor of the manhole, or is attached to the rail. The mode of grounding the lightning arrester is a disputed point to some extent, but undoubtedly a good connection to moist earth is preferable to grounding to the rail. Running the ground wire through the lateral pipe may also cause some trouble, but this is frequently done, as no better method is usually available.

These laterals, although a relatively small part of the distribution system, may, if they are improperly insulated or installed, become the weak links which determine the strength of the whole distribution system. All cables should be rubber-insulated, the clamps holding the weatherproof riser to the pole should have an insulating band between them and the pole, and the cable should be held in the clamp by a split insulator. This gives three insulations between the conductor and the pole and will practically prevent "hot poles."

When the feeders are overhead the connection to the feed span is very simple, using either a jumper or making the span up with a tail. In this case lightning arresters are spaced along the line as local conditions demand, probably about five to six to the mile on an average.

The most commonly used trolley line construction is the standard span supported on tubular two or three-section steel poles set at the curb line. The span wire almost universally used has been galvanized steel, but silicon bronze strand or copper-covered steel wire is now meeting with considerable favor. It has been found that steel strand frequently has very short life, especially in some manufacturing localities where atmospheric corrosion is especially pronounced, and other material resists such corrosion better than steel strand. The span should have two insulators cut into it between the trolley wire and the pole, and these with some form of insulating hanger for the trolley wire, give three insulations from wire to ground. Clinch ears are to be preferred to soldered ears and are more frequently used. The tendency is toward simplicity in construction, but with such means as will increase safety and reliability.

Overhead trolley special work is an important item in construction. There are many complicated layouts at busy corners, and reliability of construction is paramount. Often with long cars it is necessary to set poles considerably back of the curb line to secure proper clearance on curves, and sometimes the city authorities require that poles be set back to the building line at important corners. It is desirable to develop standard layouts which are designed with a minimum amount of overhead material, and in which the stresses are so balanced as to secure reasonable assurance of permanence in the structure. In such construction great care must be taken to align the trolley wire so that the trolley wheel can readily follow it without undue restraint.

Toughness and Tensile Strength

In the 1913 report of the Power Distribution Committee of the American Electric Railway Engineering Association may be found specifications for material and construction of overhead trolley lines. In the various annual reports of the Board of Supervising Engineers of Chicago will be found the results of numerous tests on trolley material, such as poles and strain insulators, and also descriptions of special forms of construction. One of the most difficult things to secure is a good quality of trolley wire. High conductivity has been assumed as the chief criterion in securing a first quality wire and other desirable qualities have been sacrificed to secure this one. For a city system, with dense traffic, many feeders and frequent taps, the conductivity of the trolley wire is not of paramount importance. The qualities of toughness and high tensile strength are most important and it is desirable to place an upper limit on the conductivity and make the other requirements more severe than has usually been the case. The particular qualities required and the method of securing them in trolley wire is a subject worthy of considerable study.

In any street railway system the load will fluctuate widely and it is a question of importance to determine upon what particular basis to design the feeder system. The load factor, that is, the ratio of the average load during the day to the maximum within the period, is usually from 40 to 50 per cent in an ordinary railway system. If the feeder system is designed to carry the peak loads without an overload on the cables, then during a large part of the day the current in the cables will be far below their safe carrying capacity and considerable copper will be idle. On the other hand, if the feeder system should be designed on a basis of say a six-hour average load, then the cables would be subjected to large overloads for a considerable period of time, heating would occur, the cables would more rapidly deteriorate, and a shorter life would result. The two-hour average is a good basis for feeder calculation as the ordinary percentage of load in excess of this value is well within the overload capac-

ity of the cable, especially since this excess load lasts for such a brief time. If this basis is assumed it means that the feeders will carry the entire load without being overloaded, except during two-hour morning and evening peaks.

The detailed method for computing the feeders necessary for a city system has been fully described by the writer in a paper published in the Journal of the Western Society of Engineers of June, 1910, and in the Second Annual Report of the Board of Supervising Engineers, Chicago. Briefly, the method is to determine from the proposed operating schedules the total number of cars required during the "rush hours," and plot them upon a skeleton map of the system, thus making a "spot map." The afternoon maximum period is usually the heaviest service period so that the car distribution for two hours of what is styled the "p. m. rush" is used on the map. On another map the trolley sections are indicated and the number of cars in each section determined from the spot map. This number of cars is then multiplied by the previously determined amperes per car, giving the current load for each section, which is placed at the centre of load of that section. The required number of amperes per car should be determined in all cases by tests upon the particular equipment used and service demanded. This map is the "load distribution map" and shows very clearly the energy requirements of the system.

Location of Sub-stations

A study should then be made of the proper location of sub-stations. The best probable locations and trolley sections for each station are selected and a graphical calculation of load centre for each station is made by finding the combined centre of gravity of the loads about each station. If the station locations chosen are not the most economical for distribution of copper, studies are made of comparative costs for other locations where the company may have property or where real estate may be obtained to advantage. After the station locations are definitely settled and shown upon this "station load centre diagram" and the sections to be fed from each station are decided upon, light radial lines are drawn on the "load distribution map" from each station to the centre of load of each section, which shows at a glance just what streets are fed from any given sub-station. Because of its appearance this modified "load distribution map" is known as the "spider diagram."

The most desirable routes for the cables are then determined, and the distance from the sub-station to the centre of load of each section is measured on a large scale-map. After the computation of the cable necessary for each trolley section has been made a "feeder diagram" is prepared. This shows, by a properly selected code, from which substation each trolley section is fed, the number, size and route of all cables, and whether the cable is underground or overhead.

The Size of Feeders

The calculation of the size of feeders to serve any given trolley section depends upon four elements:

1. The load in amperes upon the section.
2. The distance of the section from the station.
3. The allowable drop in the feeders.
4. The current-carrying capacity of the cables.

It is desirable to limit the cables used to a few sizes only which may be kept in stock. The labor cost of replacing cables is practically independent of the size, and the larger sizes are thus more economical than the smaller. For underground cables the 1,000,000 circular mil size is a desirable maximum as it is readily installed in a standard 3 or 3½ in. duct, in lengths convenient for handling. The current-carrying capacity of a cable does not increase as rapidly as its cross-section, because of the inability of the cable to radiate the heat developed. A great deal of study has been made upon the carrying capacity of cables but no very definite knowledge has been obtained, or at least made public, upon the safe capacity of cables of various sizes and kinds in ducts constructed in ordinary street soil. A carefully conducted series of tests, having this end in view, would be very desirable. In overhead lines the maximum size of cables is determined almost entirely by the weight of cable it is convenient to pull over the cross-arms and to handle upon the poles. Probably the most common size in city service is 500,000 circular mils.

The allowable drop in a feeder may be of any value desired and it is not usually fixed at the most economical value. For a city system subjected to large peak loads a small drop, even at peak loads, is desirable even though it is not economical with respect to feeder investment, because it is important to operate the car motors at approximately their rated voltage, and the public requires good illumination in the cars, which cannot be secured with a fluctuating voltage. A value of 10 per cent. positive line drop under peak load conditions is not too good a standard to set as this means a 60 volt drop on the common 600 volt system. Even this is too large a drop to allow unless the negative return circuit is also designed for a small drop.

The load on the trolley section and the route of the cables has been determined as previously explained. It is only necessary to measure the feeding distance on a large-scale map and then the elements of the computation are all known. The first step is to select the size of cable necessary to carry the load, and then compute the drop. In general for those sections near the sub-station the cable size fixed by current-carrying capacity is the proper size to use, but for the more distant sections the voltage drop limitation may require an increase in cable size. To make such calculations readily a chart may be used in which are curved lines of constant product, and super-imposed upon these are radial lines showing the relation between distance and drop for various sizes of cables. Numerous other means have been devised for making the same calculations, but unless there is a great deal of computation to be done at one time special methods are not needed.

When a number of stations furnish energy to a city system, each station has a feeding district of its own and may operate independently of every other. But it is usually advisable to operate such stations in parallel so as to distribute the load and to have the benefit of assistance from other stations adjacent if any one is partially or wholly disabled.

Theoretically, the best manner of accomplishing this is to provide direct equalizing ties between the positive buses of the stations just as machines are equalized in a station. The objection to this is the large cost of the cable which is necessary, and which is not utilized directly in furnishing current to the cars. Essentially the same result may be accomplished by feeding a number of the more important trolley sections from two separate sub-stations in such a way that in case of the shutdown of one station or of accident to one feeder, the cars on these sections could still be operated from the second station. These are designated as "tie-sections," and in addition to the above advantages, the feeders are so proportioned and calculated that on the whole system in case of the shut-down of one or two stations, the cars on the more important sections can be operated from the remaining stations by interconnecting through these tie sections. The amount of energy drawn over these tie lines is regulated both by the relative resistance of the cables and by voltage control in the stations. This tie line system represents in a measure the factor of safety necessary for successful operation. The number of such lines varies with the

importance of the stations and the density of traffic on the individual sections fed from them.

The Return System

The design of any overhead trolley system naturally involves provision for as direct a return of current as possible to the negative station busbar. Practically all city railway systems use grounded return circuits ,the negative side of the distribution system being connected to ground. Although utilizing the full carrying capacity of the track rails insures that the majority of the return current will follow this path, a certain proportion may reach other metallic underground structures which happen to offer another return path to the locality of the sub-stations. It is very desirable to limit these "stray currents" to a small value in order to reduce the possibility of electrolytic damage to a minimum. Another decided advantage in making the return circuit very good is of course to reduce the energy losses. It is too often the case that the return circuits, except possibly for rail bonding, are almost wholly neglected, while the positive system is carefully planned and constructed. A poorly built negative system does not jeopardize life or cause delays to the same extent as similar neglect in the positive system would do, but elements of danger and loss are present which should under no circumstances be neglected. Negative feeders are unlike positives in that the cables form a network all connected to the tracks, instead of a group of independent cables running to unconnected portions of the trolley wires. The earliest form of return circuit was the rails only, which were bonded at the joints, and later a connection was made at the power station between the rails and the negative bus. As the loads and distances increased the drop became excessive on these simple track circuits, and supplementary conductors were provided to reduce the drops. The simplest method of doing this is to provide return conductors in parallel with the rails, and in such sizes as to reduce the return drop to the required amount. As approach is made to the sub-station the current increases, due to the accumulated load, and in order to keep the return circuit from being overloaded the supplementary conductors must be increased more and more the nearer the approach to the power station. The amount of such supplementary copper necessary is computed from the allowable maximum return drop.

It is difficult to make a calculation for this supplementary copper in the case of a city system whose tracks form a complicated network of conductors. But it can be done by assuming the load distribution as in the positive feeder calculations and applying Kirchoff's laws to each element of the network formed by the intersecting tracks. The track lengths, conductivity, and loading being known the drops may be found. If the drops must be reduced, this may be done by reinforcing the track circuits by additional copper.

Connect Tracks to Return Frequently

In a grounded system, using the rails and supplementary copper for returns, in order to secure the full benefit of the supplementary copper it is necessary to connect the tracks frequently to this copper. This bond serves as an equalizer between tracks and enables the full track and cable conductivity to be utilized when the load is all on one track as well as when evenly distributed. The supplementary copper should be run through all special work and directly to the negative busbar. Where two cables cross, as at intersections, they should be electrically connected so that their equalizing effect may be realized. All rails on straight track should be at least well bonded, and preferably welded, so as to make the joint as good a conductor as the stock rail. At track special work, such as intersections, curves or crossovers, it is not usually feasible to weld at the rail joints and the special work may thus be cut off from good electrical connection with the tangent track. To preserve the conductivity of the track circuit, special work cables are run through the special work and welded to the tangent track at each end. The value of the return circuit thus does not depend upon the special work rails, which may be removed without materially affecting the conductivity.

The "insulated return system" is another method of constructing a railway return circuit. In this the return current is taken from the track circuit at various points, selected so as to maintain the track drop within any desired limits. The drop on the insulated cables may be of any amount up to the value which will cause the current to equal the carrying capacity of the cable, and the drop may or may not be of the same value on all the cables. The tendency will be for the shorter cables near the sub-station to become over-loaded and sometimes a resistance must be inserted in these cables to limit the current and make the drop approximately equal to that on the other cables. It is possible to use negative boosters with these insulated returns but they add much to the operating difficulties, and have found no favor in this country. The insulated return system has been used much more extensively in European countries than here.

Rolling Stock for Montreal Tunnel and Terminal

Previous articles in the Electrical News have described the general design of the locomotives and motor cars for the 2,400 volt direct-current electrification which the C. N. R. are carrying out on their Montreal terminals. A more complete description of these equipments as given by Mr. W. C. Lancaster, electrical and mechanical engineer of McKenzie, Mann & Company, Limited, Montreal, in the current issue of the Electric Railway Journal, in part follows:—

Locomotives

The 2400-volt d.c. locomotives are substantially the same in appearance and dimensions as those of the Butte, Anaconda & Pacific Railway. As the schedule for the locomotive trains does not call for high speed, it was not thought necessary to resort to any of the special methods of connecting the motors to the driving axles, such as are used on the side-rod and gearless types. The motors will be nose-supported in the usual way and geared to the axle by means of twin gears.

The locomotive has four axles with all the weight of the locomotive upon the eight driving wheels. The running gear consists of two four-wheel trucks, articulated together by a heavy hinge. The equalization of the trucks is accomplished by a semi-elliptic leaf spring over each journal box, connected through spring hangers to the frame and to the equalizer bars. The equivalent of a three-point suspension is thus obtained through the side equalization of one of the trucks and both side and cross equalization of the other truck.

The friction draft gear is mounted in the end frame casting of the truck. The cab, which is of the box type, is divided into three compartments, the centre compartment for the apparatus and the two end compartments for the operator. Each operator's compartment is supplied with controller, control switches, ammeter, air brake and pantograph control, air gages, 2400-volt cab heater, bell rope and control for the whistle and sanders, thus providing the locomotive with complete double-end control.

The motor equipment consists of four GE-229A commutating pole motors wound for 1200 volts and insulated for 2400 volts, two of these motors being permanently connected in series for operating on the 2400-volt trolley cir-

cuit. The one-hour rating of each motor is 315 h.p. at 1200 volts. The motors are designed for forced ventilation, which is obtained by means of a blower in the locomotive cab. Either pair of motors may be cut out, in case of emergency, by a special handle on the change-over switch. The locomotives are geared for a free running speed on tangent level track of approximately 45 m.p.h. and are operated as two-speed machines with ten points in series and nine points in series-parallel. The master controller used is of the non-automatic type and has two handles, one regulating the applied voltage at the motors and the other for controlling the direction of rotation of the motors. The rheostats which form the external motor resistance are placed near the roof of the cab and provided with ample natural ventilation.

The master controller and contactor energizing circuits are designed for 125 volts. Each contactor is easily accessible without any disturbance to adjacent contactors. A special electro-pneumatic change-over switch is used for making the transition between series and series-parallel connection of the pairs of motors.

The 125-volt current for operating the contactors and for lighting the cab and headlights is obtained from a motor-generator set, the motor of which has two 1200-volt windings and two 1200-volt commutators in series for operation on 2400 volts. This set is mounted in the centre cab and also drives the blower for providing forced ventilation to the main motors.

Fuses of the copper ribbon type placed in fuse boxes provide protection for each individual circuit as well as the main circuit from the trolley. These fuse boxes are all arranged to blow into a common chamber designed to take care of the arc. In addition to the fuse on the main circuit, a main switch is also provided. This is of the knife-blade type, being opened and closed by a handle placed in a position for easy operation in case of emergency or when it might be necessary to open the circuit while carrying current. This main switch blows into the chamber provided for the fuses, and has a powerful magnetic blowout.

Pantograph Type Trolleys

The trolleys are of the Butte roller pantograph type, pneumatically operated and mounted on insulated bases. Two pantographs are used per locomotive. A hand pump is provided in case a locomotive has been standing for some time and has no air supply.

A Warner speedometer, similar to the type largely used on automobiles but especially designed for locomotives, is located in each operating cab. These will be connected to the driving wheels of the locomotive by means of flexible shafts and gearing.

A combined straight and automatic air-brake equipment is provided on each locomotive. This equipment includes a 2400-volt motor-driven air compressor, the set consisting of two 1200-volt motors operating in series on 2400 volts and direct-connected to an air compressor having a displacement of 100 cu. ft. of free air per minute. The approximate total weight of each locomotive is 83 tons. Some of its principal dimensions and characteristics are given in the following table:

Length inside knuckles	37 ft. 4 in.
Length over cab	31 ft. 0 in.
Overall height, pantograph down	15 ft. 6 in.
Height over cab	12 ft. 10 in.
Over-all width	10 ft. 0 in.
Total wheelbase	26 ft. 0 in.
Rigid wheelbase	8 ft. 8 in.
Total weight, all on drivers	83 tons
Wheel diameter	46 in.
Tractive effort at 30 per cent tractive coefficient	49,800 lb.
Tractive effort at one-hour rating	20,300 lb.
Tractive effort at continuous rating	14,500 lb.

A floor plan of the cars shows that no sliding doors are used, as such doors tend to weaken the car just where most strength is required in case of collision. All the doors swing, so that the corners of the cars may be made as strong as is necessary. Cross seats are used near the centre of the car and longitudinal seats near the ends. This arrangement gives plenty of room near the doors where most of the crowding occurs when passengers are leaving or entering. It also tempts the passenger by means of the more comfortable cross seats to "move up to the centre of the car." The underframing is entirely of steel. The car body is also of steel except for window frames, wainscoting, side posts and part of the floor, which are of wood, and the headlining, which is of a heat-resisting, pressed-fibre board.

The underframing is of the centre box girder construction, employing two 9-in. 15-lb. channels spaced 16¾-in. back to back and fitted with a top cover plate 26-in. x ¼-in. and a main bottom cover plate 24-in. x ⅜-in. The body and end sills are of structural steel shapes. Trap doors of Edwards all-steel construction are installed. The bolsters are built up of plates and angles. The Standard Coupler Company's buffers and Miner draft gear are used.

The flooring consists of a bottom layer of tongue and grooved spruce, on top of which is spread a layer of three-ply "Salamander." Between this and the main floor is an intermediate insulating floor formed of ⅛-in. steel plate, on top of which is also laid a layer of three-ply "Salamander." The main steel floor, on top of which is spread a layer of "Flexotile" composition flooring, consists of "Chanarch" steel.

As regards the side framing, the main side posts are formed of 3-in. x 2-in. x 5/16-in. rolled steel angles acting as a stiffener for the side sheeting and a suitable connection for the wooden side posts. At the belt rail the sheeting is further stiffened by a 4-in. x ½-in. bar extending the full length of the body. The corner posts are built up of 3-in. x 2-in. angles with 3/16-in. pressed steel cover plate extending around and over the side and end sheets. The side sheets are of 0.110-in. thick cold rolled steel plate.

Particular attention has been given to the heat insulation. For the sides, roof and ends of the car this insulation consists of three-ply "Salamander." It is secured to the steel by means of glue and the Cleveland Tack Company's "Clinchtite" nails spot-welded to the sheet steel and provided with steel retaining bands. This method is similar to that used by the New York, Westchester & Boston Railway.

The Trucks

The trucks are of this railroad's plate frame construction built for a centre plate capacity of 40,000 lb., and they are of the side equalized type. Case-hardening is applied for all hangers and rod jaws, for all pin ends of levers and where all holes occur in the same. The wheels are of rolled steel and are 36 in. in diameter. The journals are 5½ in. x 10 in. and of the American Electric Railway Association standard with McCord boxes.

The outside and inside finish and all fittings and other details are made to conform as nearly as possible with Canadian Northern standard practice.

The principal dimensions are given in the following table:

Length over buffers	67 ft. 5¾ in.
Length over body corner posts	57 ft. 6¼ in.
Truck centres	42 ft. 9 in.
Width over side sill angles	9 ft. 10½ in.
Width over eaves	10 ft. 2¾ in.
Height top of rail over roof	13 ft. 0 in.
Height top of rail to underside of side sill	3 ft. 7½ in.

Centre to centre of body side bearings . . .. 4 ft. 10 in.
Centre to centre deck sills . . . . 5 ft. 6 in.

The approximate weight of the car loaded and equipped is 160,000 lb.

The electric hot air system of car heating is used. One complete heater is placed underneath each car and receives its energy direct from the 2400-volt supply. The heater has a capacity of approximately 25 kw. and is constructed for two heat combinations so as to provide for the changes in temperature conveniently and economically.

The complete heating equipment consists of the heating unit, blower and regulating mechanism, the controlling switch and thermostat of the regulating mechanism being arranged for operation from the 600-volt supply. Air is forced over the heating unit by means of the blower and distributed to the car through the air ducts along the sides of the car. The blower used for the circulation of the air is operated by a motor which is connected in series with the heating unit on the ground side. The capacity of the blower is approximately 1,000 cu. ft. of air per minute.

Motor Equipment

The motor equipment consists of four fully ventilated GE-239A, 125 h.p., 1200-volt commutating pole motors insulated for 2400 volts. Two of these motors are permanently connected in series for 2400-volt operation. Ventilation of the motor is accomplished by drawing air into the armature at the pinion end by means of the fan on the armature shaft. The air passes longitudinally through the whole interior of the motor and is expelled through an opening in the frame at the commutator end. This opening is protected by wire mesh. A back view of the brush-holder and support is also shown.

The control is of the non-automatic type for multiple-unit operation. The equipment includes a motor-generator set for furnishing 600-volt current for the control circuits, the air compressor and lighting circuits. This set consists of two 1200-volt motors, operating in series on 2400 volts, direct-connected to a 600-volt generator. The master controller, contactors, switches, reverser and pantograph are of essentially the same construction and appearance as those already described for the locomotives. The controller will have five steps in series and four steps in parallel. It differs from the locomotive controller in having the usual motorman's operating handle instead of a lever. This handle is provided with means for cutting off power and applying air brakes in case the motorman removes his hand.

Copper ribbon fuses similar to those on the locomotive will be used and an aluminum cell lightning arrester is installed on each car.

Railway Electrification in England

The London & North Western Railway Company have under way the electrification of some eighty miles of single track, the first section of which was placed in operation on May 1st, of the present year. This consists of West London section from Willesden Jct., to Addison Road, and from Addison Road to Earl's Court; in all about seven and one-half miles of single track has been equipped to date. A brief description of the completed part of the system is described in the current issue of the Tramway and Railway World. High tension cables will, as far as possible be carried on short posts along the railway. The low tension cables will be laid underground. The conductor rails are all of a special low carbon soft steel having a weight of 105 lb. per yard; the electrical resistance is approximately six and one-half times that of copper. They are supported on porcelain insulators attached to the sleepers by malleable iron clips.

Trains, such as it is proposed to operate on these lines, will consist each of three cars having a total length of 179 feet. End doors are used with through communication, and both cross and longitudinal seats are provided. The electrical control gear will be supplied by the Siemens Companies. Every motor car will be fitted with four motors of 250 h.p. each.

The generating equipment will consist of five turbo-generators of 5,000 kw. each, three-phase, 11,000 volts, 25-cycles; transformers and rotary converters will be used to reduce the current to 600 volts d.c. Storage batteries will also be installed for peak and emergency service.

The transformers are being manufactured by the British Electric Transformer Company; sub-station plants by the British Thompson-Houston Company; the electrical apparatus of the trains by the Maschinenfabric Oerlikon.

Personal

Mr. W. D. Gilroy formerly of Nelson has been appointed manager of the Kootenay telephone lines.

Mr. G. W. Robb has resigned the position of superintendent of motive power of the Grand Trunk Pacific Railway, and is succeeded by Mr. Joseph Billingham. Mr. Billingham was at one time connected with the London & North Western Railway, England. He will make his headquarters at Transcona, Man.

Mr. G. Gordon Gale for many years general superintendent of the Hull Electric Company has recently been appointed general manager of the company. Mr. Gale is a graduate of McGill University and has had valuable experience both in operation and management. Prior to 1907 he was assistant engineer of the electric plant of the Canadian Rubber Company. In that year he became associated with the Hull Electric Company and has filled successfully the positions of superintendent of power, acting superintendent, and, for the last five years, general superintendent. Mr. Gale's company, in addition to operating a railway system, furnish light and power in Hull, Aylmer and intervening points.


Mr. G. Gordon Gale.

The Philadelphia Rapid Transit Company have closed a contract with the Duff Manufacturing Company, of Pittsburgh, to have every car on their system equipped with the "Barrett" emergency car jack.

The Canadian Vickers, Limited, Montreal, recently purchased a 600 ampere arc welding set from Mr. J. D. Lachapelle, Canadian sales manager of the C. & C. Electric & Manufacturing Company.

Illumination

"White Way" in Edmonton

The accompanying photograph represents the new "White Way" lighting on Jasper Avenue, Edmonton, Alta. This street was formerly lighted by magnetite arc lamps perched on the top of the trolley poles in the contre of the street and fed from mercury rectifiers by an overhead line. Early in 1914 work was commenced on the installation of a row of ornamental standards on each side of the street. These also carry magnetite lamps furnished by the C. G. E. Company. The feed wires for the new sytsem are underground, a trench being dug in the sidewalk about 12 inches from the curb. A 2½ in. fibre duct is installed in the trench and filled in with concrete.

The Great White Way, Jasper Ave., Edmonton.

In the outlying districts where permanent sidewalks are not yet placed, a concrete pier was built to support each standard and the armoured cable placed in a trench about two feet deep. Some 90 new lamps, representing about half what the city plans to put in service in the near future, were turned on on July 14. The illumination resulting from the new installation is very effective. The work was carried out under the supervision of Mr. A. W. Ormsby, superintendent of the light and power department, and Mr. Ingalls in charge of the arc lamp department.

Electrical Street Decorations in Seaforth

As a decorative and attractive feature the profuse use of electric light is becoming one of the most important factors in "home coming" demonstrations and similar festivities, as practiced in our Canadian towns and cities during the recent past. This was demonstrated in a remarkable way at last month's "Back to Seaforth" gathering, where a thrifty population of something less than 2,000 souls transformed itself into a city of considerable dimensions chiefly by making itself look big on the map through an almost prodigal use of tungstens. It is said that no less than 10,000 lamps were used in this demonstration, and a view of the main street as shown herewith lends credence to this report.

Features of the demonstration included a large electric "Welcome" sign at the depot; a Court of Honor located about half way along the main street, donated by the Knights of Pythias Society; elaborate decorations on the town hall; and suitable and characteristic signs by the various fraternal societies, such as the C. O. F.; A. O. F.; L. O. L.; I. O. O. F.; and A. F. & A. M. The K. O. P. had individual illuminated decorations characteristic of their respective societies. Numerous merchants also installed displays of their own using all the way from 50 to 500 lights each. The wonderful lighting effects are credited largely with the success of this reunion which both in numbers and financially is something which Seaforth will long remember with pleasure. Electric current for the demonstration was donated by the Hydro-electric Power Commission, the entire installation being illuminated from dusk till about 2 a.m.

The entire decorative work was in charge of the Electric Decorative & Equipment Company, 70 Lombard Street, Toronto, who have been making for themselves a very enviable reputation by this and similar installations at various points in the province. This company specialize on decorative lighting and prepare regular plans and sketches for the entire scheme and co-operate with local authorities and with individuals so as to obtain the best possible general effects. The wisdom of such an arrangement is at once evident. A number of individual attempts at decoration are very apt to run into a lot of money without producing much in the way of general effect. As in everything else the combination of forces under skilled supervision gives best results.

"Back to Seaforth" street decorations.

The Dealer and Contractor

Model Plans and Specifications

For an average size residence—Of special interest and value to Electrical Contractors and Architects

We print herewith a typical set of plans and specifications for the wiring of a residence of average size. The dimensions of the house, verandas excluded, are 38 x 26 outside measurement.

It is not expected that these plans will coincide with the individual tastes or requirements of every house builder. We believe, however, that they represent a fairly ideal installation taking into consideration the comfort and requirements of the average citizen. In this connection we mention below a number of features which, without adding anything appreciable to the cost of the installation, materially assist in perfecting the refinements of control and make for convenience and economy of operation.

(1) Absence of brackets—It will be seen that there are practically no wall outlets, these being confined to the one in the pantry, one in the attic hall and one in each of a number of closets. Even in these isolated cases a little added expenditure would have been justifiable and have made the installation, in our estimation, still more perfect. The idea is, however, that all brackets shall be controlled by pull chains, these being especially satisfactory for the closet lamp which is intended to be installed immediately above the door way with the chain hanging three or four inches below the frame; this can be picked up easily in the dark by running the hand along the top of the frame. The objection to brackets is daily becoming more universal. They are generally in the way of furniture or decorations; they collect dust and dirt; they engender untidiness as they are often used as hooks, and at best they only localize the light. All the advantages of the wall lamp, without the disadvantages, are found in the baseboard receptacle of which these plans show a liberal number.

(2) Arrangement of circuits—The baseboard receptacles in this plan are kept on separate circuits by themselves. This arrangement gives two circuits in every room so that in the event of an interruption on one circuit the room will not be left entirely without service and a fuse being blown by a fault developing in a worn flexible cord will not interrupt the lighting of any regular ceiling outlet. This gives a somewhat larger number of circuits than is absolutely necessary and takes a few feet more wire, but it has the advantage of allowing a liberal capacity on every circuit so that if an unexpectedly large load is taken from any outlet that circuit is not likely to be dangerously overloaded.

(3) Special closet outlets—As already noted a small wall lamp is provided above the door in each closet. The additional expense for these outlets is very small, the current consumption will be negligible and the added convenience, especially in closets the shape of those shown, is very material indeed. Especially where clothing or supplies is placed on shelves a good lighting is necessary to maintain a proper tidiness. Such a light in the medicine closet will tend to prevent the use of carbolic acid for castor oil.

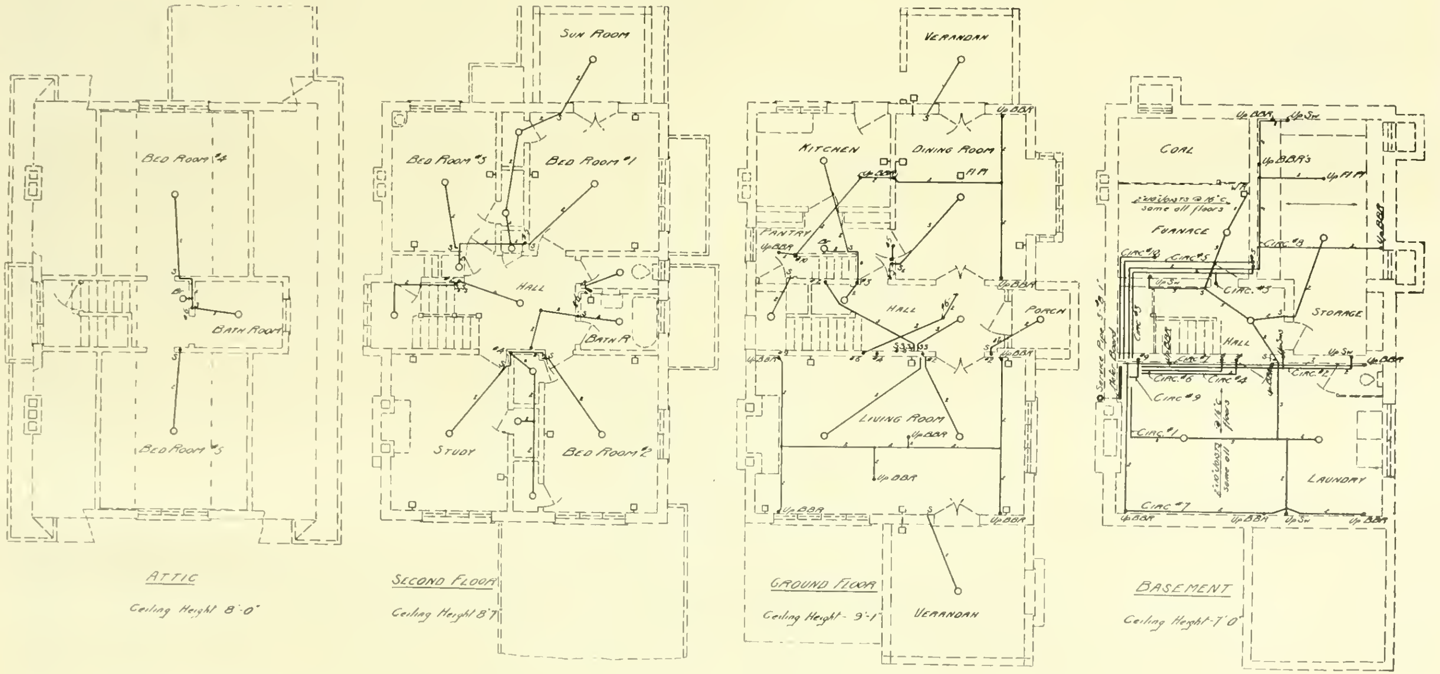
(4) Switch controls—The arrangement of switches in the main halls would appear to be especially convenient without over-elaboration. It will be noted that the lamp in the lower hall is controlled by three switches consisting of the usual two three-ways, one upstairs and one down, and an extra three-way downstairs placed in series with the other two and which acts as a selective switch. This makes possible the use of either a small light or a brilliant light as desired, a small lamp being considered sufficient in most halls the greater part of the time. Three-way switches are not installed to control the attic hall light though this is a convenience many householders would add.

The dining room light is controlled by a two point electrolier switch which admits of low light being used for setting and clearing the table. The rear entrance light is operated from the same switch as the basement hall, it being considered that the former will rarely be needed except when going down cellar and also that it will serve as a pilot to show when the basement light has been left burning. The intermediate landing light is also controlled with the upper hall since this will be a small wattage lamp and is generally needed when the upper hall is needed. Electrolier switches for the living room, though not installed in this plan, would probably be considered essential in the average case as they would make possible better general control of the illumination as, for example, when a number of localized lamps are being lighted from the baseboard receptacles and the full ceiling illumination is not required.

(5) The service is made heavy enough to stand the addition of an electric range. Though in this particular case the wires have not been installed this is only because their installation at a later date will be an exceedingly simple matter.

(6) Ironing outlets—In the back verandah and in the kitchen where ironing is most likely to be done, outlets have been placed high (6 ft. from floor) so that the ironing cord will not interfere with the work. These outlets are equally valuable for any other apparatus. We believe this is an important feature for the hanging cord so often installed in the ceiling is unsightly and does not admit of an absolute uniformity of base receptacle and plug throughout the building—a very important consideration. Individual requirements may demand a similar outlet in the laundry.

(7) Baseboard receptacles—A liberal number of baseboard receptacles are installed at convenient places. These will carry lamps, toasters, water-heaters and, above all, small electric heaters for spring and autumn use before the furnace is operating. A receptacle has been placed on the front verandah as this, if windowed, is most likely to be the place where an afternoon tea or a lazy breakfast will be served. The floor plug in the dining room is also calculated to supply a sufficient number of electric utensils to cook a small meal. The plan suggested is to connect a plug in the floor with two or more flush plugs at convenient



Model wiring diagram, for illumination purposes, of a typical residence of average dimensions—Also see specifications.

points in the table. The unsightly appearance of a number of cables hanging from your electrolier is thus avoided. The floor contact also is a permanent one and need only be removed in case the table is to be moved a considerable distance. The two additional baseboard outlets at the sideboard and buffet will admit either of decorative lighting or frying operations which might spoil the table linen.

(8) It will be noted that no provision is made in the hall for the operation of an electric sweeper. It may be contended that the liberal distribution of baseboard outlets in the various rooms would serve this purpose, but we believe it would be better to have a separate power outlet for each hall so that the stairways especially may be reached. This is particularly true of the upper flat where baseboard outlets in the different rooms have not been specified. A hall outlet will, in this case, serve to operate a vacuum cleaner at any point on this flat. It may be contended that in the strictly modern house a stationary vacuum cleaner should be installed, but we believe it is open to question whether a house of the size represented here would be justified in including what may yet be considered as something of a luxury. Much will depend, of course, on the method of furnishing to be adopted. With the modern fairly general unpopularity of carpets and their replacement by small rugs the necessity of the large vacuum cleaner is not so apparent .

(9) No mention is made in the specifications of wiring for bells or annunciators, but this is a matter about which individual tastes differ very widely. In the particular house under discussion we have been given to understand that the front door is connected with one bell and the back door with another; also that the dining room and living room are connected to a (the same) buzzer. In a house of this size upstairs bells hardly seem to be necessary though some householders prefer one push button at least upstairs, which might, in this case, be connected with the front door bell. In the dining room connection is made with a push button in the table through a floor outlet, and a push button in the living room is so located that it is easily accessible from the front veranda. Again it is a matter of individual taste whether these bells should be operated off batteries or a transformer. The strictly modern installation would use the transformer, but where small economies are a consideration it is possible the batteries will be favored.

SPECIFICATIONS

These specifications are intended to cover the supply of all necessary material and labor for the installation of a complete wiring system for lighting, etc., in the new residence for ... ... Toronto.

Working Conditions

1. House is built and roofed but not finished. Electrical work may be started immediately.

2. House is of standard brick construction.

Plans

Plan No. C-38 shows the "Wiring Plan of Residence," and shall be considered as forming an integral part of these specifications.

Circuits are indicated by single heavy lines, the number of wires in each run being marked by small numbers.

In all cases, circuits are located between the ceiling of the floor, on which they are shown, and the floor above.

Detail Specifications

1. Install standard service pipe in rear of house, as shown, same to consist of three No. 8 wires in 1-in. conduit.

2. Install meter board 3 ft. wide by 2 ft. high covered with a clear sheet of ¼-in. asbestos, painted black.

3. On meter board install one 3 p.s.t., 250 volt, 60 amp. knife switch and five 3 to 2 wire double branch fuse blocks with fuses and make all necessary connections ready for meter.

4. Install 10 branch circuits throughout the house as shown on the plan and detailed in the following summary:

Circuit Summary

Circ. No.	Location	Ceiling Outlets	Bracket Outlets	Base Board Outlets	Switches	Watts	Side Service
1.	Basement						
	Laundry	2	..	..	1	..	R
	Verandah .. .	1	..	..	1		
	Hall	1	..	..			
	Rear Entrance.	1	..	..	1	440	
	Storage	1	..	..	1		
	Furnace	1	1 W.R.	..	1		
2.	Ground Floor						
	Living Room.	2	..	..	2		L
	Porch	1	..	..	1		
	Lower Hall. .	1	..	..	2 (3w) 1 (El)	460	
	Upper Hall ..	1	..	..	2(3w)		
	Landing	1					
3.	Ground Floor						
	Dining Room.	1	..	..	1 (El)		R
	Coat Room		1	..	..		
	Kitchen	1	..	..	1	400	
	Pantry		1	..	..		
4.	Second Floor						
	Study	1	..	..	1		L
	Bedroom No. 2	1	..	..	1	440	
	Closets		3	..	..		
5.	Second Floor						
	Bedroom No. 1	1	..	..	1		R
	Bedroom No. 3	1	..	..	1	460	
	Closets		4	..	..		
	Sun Room ...	1	..	..	1		
6.	2nd and 3rd. Flrs.						L
	Bath Room ..	1	..	1	1		
	Toilet	1	..	..	1		
	Bath Room ..	1	..	..	1	360	
	Upper Hall		1	..	..		
	Bedroom No. 4	1	..	..	1		
	Bedroom No. 5	1	..	..	1		
7.	Ground Floor						R
	Living Room.	1	..	6	..	420	
	Verandah		..	1	..		
8.	Ground Floor						L
	Kitchen		..	1	..		
	Dining Room. ..		..	2 (1Fl.Pl.)	..		
	Verandah .. .	1	..	1	1	360	
9.	Second Floor						L
	Study		..	3	..		
	Bedroom No. 2 ..		..	3	..	360	
10.	Second Floor						R
	Bedroom No. 3 ..		..	2	..	300	
	Bedroom No. 1 ..		..	3	..		
	Totals	26	11[1]	24[2]	26[3]	4,000[4]	

[1] 2 standard, 8 closet, 1 wall receptacle.

[2] 23 standard, 1 floor plug.

[3] 20 standard, 4 3-way, 2 electrolier.

[4] 2020 R, 1980 L.

Nature of Work

1. All work shall be standard "knob and tube" construction, in all respects of the most up-to-date practice and best workmanship.

2. All wires brought down walls of basement to switches, etc., must be run in metal moulding.

Location of Outlets

1. Ceiling outlets must be accurately located so as to bear a proper relation to decorative detail.

2. Bracket outlets in all closets to be located immediately above the centre of the doorways. (It is intended to equip these with pull receptacles).

3. Other bracket outlets in pantry and top landing to be located 5 ft. 6 in. above floor.

4. Baseboard receptacles to be mounted 6 in. above floor. except kitchen and back verandah, which are 6 ft. above floor.

5. Switch outlet to be mounted 4 ft. above floor unless special wall details require otherwise.

6. In any case where the direction of door swing is reversed from that shown on the plan, the switch must be changed to the opposite side correspondingly.

7. Switch outlets located on any panelled wall must be carefully centered.

Control

1. All switches indicated on the plan will be of a standard single pole type controlling one outlet only, with the following exceptions:

(1) Both laundry outlets to be controlled together by the same switch.

(2) Rear entrance and basement hall to be controlled together by the same switch at pantry door.

(3) Main hall to be controlled by a pair of 3-way switches in lower and upper halls and also with a single button, 3-way switch serving as an electrolier switch.

(4) Upper hall and intermediate landing to be connected in parallel and controlled together by a pair of 3-way switches in lower and upper halls.

(5) Dining room to have a 2-circuit electrolier switch.

Fittings

1. Switches.

(1) Basement switches to be rotary snap switches of approved type.

(2) All other switches to be push button switches of best quality Perkins or equivalent.

(3) Electrolier switch for hall to be a single button 3-way push switch, Perkins Type 0 No. 2458 or equivalent.

(4) Electrolier switch for dining room to be single button, 2 circuit push switch, Perkins Type 0 No. 2460 or equivalent.

2. Switch Plates.

(1) All switch plates to be nickle finish unless otherwise required to agree with room hardware.

(2) Upper hall plate to be standard 2 gang plate.

(3) Lower hall plate to be a single plate providing for 4 two-button switches and one single button switch, Perkins No. 3655 or equivalent.

3. Baseboard Receptacles.

(1) All baseboard receptacles to be uniform and of best quality Diamond H or equivalent.

(2) No plugs to be supplied.

(3) Finish of face plates to agree with other hardware of room.

1. The "General Conditions" attached herewith shall be considered as forming an integral part of these specifications.

2. All materials and workmanship shall conform to the requirements of the Canadian Fire Underwriters' Association and their certificate furnished at the completion of the work.

General Conditions

1. These General Conditions shall be considered as forming an integral part of any specification to which they may be attached and shall be absolutely binding in carrying out any cotnract awarded in accordance with such specifications.

2. The following interpretations shall be taken of terms used throughout the specifications:

The Proprietor means the party or parties who own the building or properties in which the contract is to be fulfilled. In this case ... ...

The Contractor means the party or parties to whom any contract may be let on the basis of these specifications.

The Architect means the architect or firm of architects under whose charge the building work is being carried on and who is exercising supervision over any or all trades which may be doing their work at the same time as the work called for under these specifications. In this case ... ...

The Engineers mean the enigneers who have drawn up these specifications and under whose supervision any contract awarded on the basis of such specifications must be carried out, namely Messrs. Ewart & Jacob.

3. The contractor (unless otherwise specified) shall provide all materials, workmanship, plant, scaffolding, carriages, freightage and every other matter that may be required for the proper performance and completion of the work and the whole of which are to be the best of their several kinds.

4. The plans accompanying these specifications shall be considered an integral part of the same. Specifications and accompanying plans are intended to co-operate, so that any work shown on the plans and not mentioned in these specifications, or vice versa, is to be executed the same as if set forth by the plans and mentioned in these specifications.

5. Should any drawings or figures be omitted in the plans and details, which are necessary to a clear, comprehensive understanding, or should any error appear in either plans or specifications, it shall be the duty of the contractor to notify the engineers in writing of such omission or error before submitting tender and in no case proceed in uncertainty with the work.

6. If in the opinion of the contractor a change of plans or specifications should be made for the proper completion of the work and if such change alters in any way the original amount of the tender, the contractor must notify the engineers and submit price in writing for approval before starting the work, otherwise the engineers will not recognize any change in plans or specifications and no claim for extra payment will be allowed.

7. The plans accompanying these specifications are made as accurate as possible, but absolute accuracy of dimensions cannot be guaranteed. No claim for extra payment on account of difference of actual and estimated dimensions shall be allowed, unless such difference arises through alteration of building plans by the architect, or unless such difference shall be greater in amount than ten per centum in each case. On all plans figured dimensions are to be taken in preference to measurement by scale and drawings on a large scale are to be taken in preference to those on a small scale.

8. On all plans, the correct size, location and nature of all walls, partitions or obstructures of any kind are indicated as accurately as possible. If any additional obstacles are encountered the contractor must make good all work through or around such obstacles the same as if they had been originally indicated and no extra claim shall be allowed on account of such obstacles.

9. The contractor shall at his own cost make good any defects, settlements, shrinkages, burn-outs, grounds or other faults in his work, arising from defective or improper materials, which may appear within twelve months after the completion of the contract.

10. The engineers reserve the right to reject any and all materials which, in their opinion, are unsuitable for the proper completion of the work, or not in accordance with these specifications or accompanying plans. Such rejected mater-

ials must be removed from the premises forthwith, and if used after such rejection the contractor shall, at his own cost, tear down such materials and replace same with approved materials.

11. Successful contractor shall be required to sign the specifications and accompanying plans as well as revised contract form in which shall be stated manner of payment, time limit, amount of tender, etc.

12. The proprietor reserves the right to accept or reject any or all bids presented in determining to whom said contract will be awarded. The tenderer's reputation, as well as the amount of his proposal, will be considered and the contract made in accordance therewith.

13. The contractor will notify the engineers in writing when his contract is completed. This dated letter will be necessary to obtain his final certificate, which will be issued within thirty days after notification, if the engineers, on inspecting the work, consider the same complete.

Overhead Charges—The Cost of Doing Business

This is the way the Joint Conference Committee of the National Association of Master Steam and Hot Water Fitters and the National Association of Master Plumbers puts the case:

The ordinary estimate, while made up of a great many items, may, for the purpose of this discussion, be summarized under four principal headings as follows:

1. Cost of Materials.
2. Cost of Labor.
3. Cost of Doing Business. ("Overhead Charges").
4. Profit.

As to the cost of materials, there is no good reason why every bidder who exercises due care in taking off his quantities, and who really knows how to take off those quantities, should not have approximately the same amount to cover this item.

Cost of labor is in every sense an estimated item—no one can state definitely just how many days will be required to do a certain piece of work. We all have ideas as to the time required, and these ideas are in most cases backed by experience, but after all it is largely a matter of judgment —with many of us it seems to be a matter of positive guesswork.

There are no rules laid down which govern this all important item, but if its cost is made up honestly by one who is fitted to do it, if due consideration is given to the required time for each particular part of the work, if the time is based not upon what the quickest and cleverest journeyman is able to accomplish but upon what the journeyman of average ability can do; if due allowance is made for lost time and for smoothing out the many perplexities which always arise on any job, then we shall be more nearly together in our estimate of the number of days required.

With the cost of labor as high as at present, we cannot afford to estimate an insufficient amount to cover it, for if our actual time exceeds very many days our estimated time, our entire profit in many instances is eaten up.

In many offices, on all important work, no less than three (many times as many as five) competent men estimate on the item of labor, each absolutely independent of the other. If the time estimated by these men runs fairly close, then the average is usually accepted; but if there is a wide difference, then the three or more get together and go over the work item for item, and discuss it pro and con, and finally decide what amount is to be used.

You may say that you have no one but yourself to depend upon for this work. If that is so, call up your foreman; and if you have no foreman, talk it over with one of your journeymen in whose judgment you may have confidence.

Finally: If you must guess—guess big and then double it.

Now we come to the cost of doing business, or more briefly called overhead charges. The item is perhaps less generally understood than any other in the entire estimate.

Many of us are what are known as "practical" men. We may not have enjoyed much of a business training, but have acquired what knowledge we have in the hard school of experience—with the tools and on the job. Others of us lack this practical knowledge, but have secured our training through the office end of the business—the school of system and of cost and profit.

Each of us has much to learn from the other, but what we all should know is what "overhead charges" really means.

In the conduct of a business, however small, there are certain items of expense for which we have to provide, whether our sales are large or small—they are unavoidable and cannot possibly be side-stepped.

1. The rent has to be paid.
2. The bill for heat and light has to be paid.
3. The salaries of bookkeeper, stenographer and salesmen have to be paid.
4. Liability insurance on workmen has to be paid.
5. Fire insurance on shop, tools and merchandise has to be paid.
6. The telephone bill has to be paid.
7. The bill for cartage has to be paid.
8. Interest on invested capital must be considered.
9. Depreciation of tools and replacement of them must be considered.
10. Percentage of bad accounts must be considered.

These may not be all the items, and probably are not, that go to make up the major item of overhead charges, but they are sufficient in number to cause each one of us to realize the supreme importance of this division of our cost and how absolutely foolish it is for us to assume that we can keep on in business without making any charge for it.

It is just as surely a part of our cost as any article of merchandise which we estimate to furnish. In amount it will vary according to the extent of the business and the prudence or extravagance with which the business is conducted, but it is always there and cannot be lost sight of. Each one can determine for himself just how much of an item this is—experience has taught, those of us who keep an accurate account of such matters, that it is rarely less than fifteen per cent. of our gross volume of business.

In other words, if our gross sales amount to $100,000 per year, our overhead charges probably amount approximately to $15,000 and this $15,000 has to be provided for before you can hope for any profit. It is a part of the cost.

With reference to item four, The Profit, men differ as to what they consider a proper amount, but nearly everyone agrees that it should never be less than ten per cent. It is our opinion that never less than fifteen per cent. should be charged, and this, on small jobs, is not sufficient.

It is well to remember that there are lean years as well as fat years and the percentage of profit must be of such extent as to average well over a long period, if we hope to keep going. So then, our cost should be made up as follows:

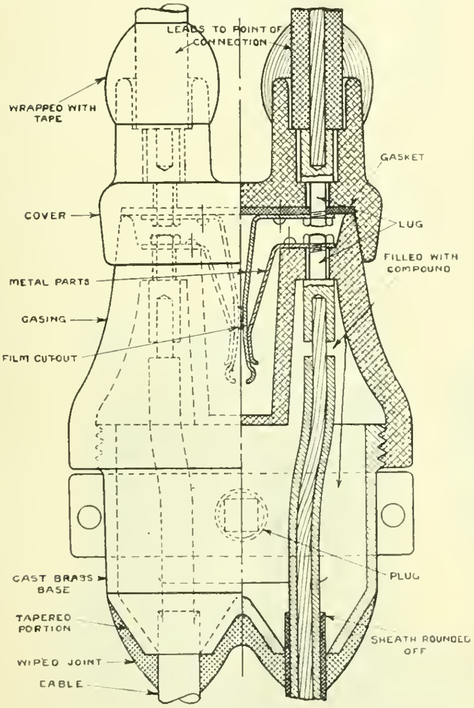
1. Merchandise.
2. Labor.
3. Overhead Charges.
4. Profit—not forgetting Overhead Charges.—"How."

The Harland Engineering Company, power engineers and contractors, have removed from 26 Victoria Square to larger offices at 102 St. Antoine Street, Montreal.

Combination Cable Terminal and Series Cut-out

A somewhat new departure in the way of a combination cable terminal and series cut-out, has been recently put on the market by the Northern Electric Company. This cut-out can be used to advantage on all series arc and incondescent street lighting circuits up to 7,000 volts, and is particularly adapted for use inside the post pedestals of ornamental street lighting systems. By reference to the sketch ,a general idea of the design can be obtained.

The cut-out consists essentially of three parts:—(1) A brass base in the form of a wiping sleeve; (2) a casing, and (3) a covering of insulating material, fitted with brass and phosphor bronze parts which pair in such a way as to provide the series cut-out feature. The rubber insulated leads



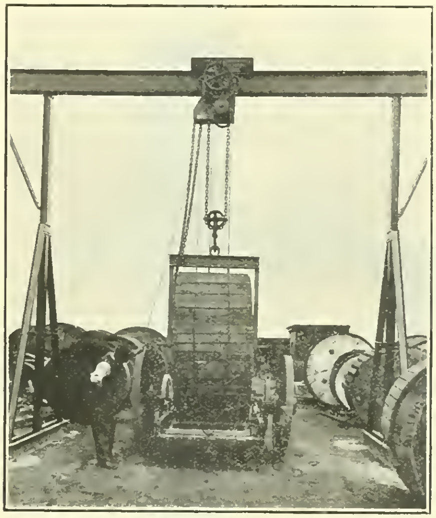
METHOD OF CONNECTING COMBINATION TERMINAL AND SERIES CUT-OUT

to the lamp are connected to the cover, while the lead-covered cables of the main circuit enter the brass base and are held in place by means of a wipe joint, the casing and base being filled with compound, hermetically seals the ends of the cables and provides the cable terminal feature. When any particular lamp fails, a film cut-out, which is interposed between the metal parts on the cover, fuses and maintains the continuity of the main circuit. The cover is then removed which open-circuits the lamp and repairs can be made, the continuity of the circuit being maintained in this case by the springing together of the metal parts in the casing. When the lamp has been repaired the cover is simply shoved down into place, which again puts the lamp into circuit, neither operations necessitating any interruptions in the service.

On street lighting systems it is very often required to run a series branch off the main circuit up a side street. By means of a special wiping sleeve connection, which allows for the entrance of four single conductor cables, this series branch connection can be made. The cut-out can also be used with double conductor cables or a combination of double and single conductor with the same facilities as with single, the only alteration necessary being the modification of the cable entrances in the brass base. The design besides presenting a very neat external appearance, possesses all the moisture resisting properties of a terminal in conjunction with the advantages secured by the cut-out devices described above.

Cable for Loading and Unloading

The Toronto Hydro-electric System have recently installed a labor-saving device which has proved itself very effective in operation. This consists of a fixed Goliath crane which has been set up in the William Street store yard, where it is used for loading and unloading the heavy reels of cable, some of which weigh close on five tons each. One man is left in charge of the yard, and he is now able to take



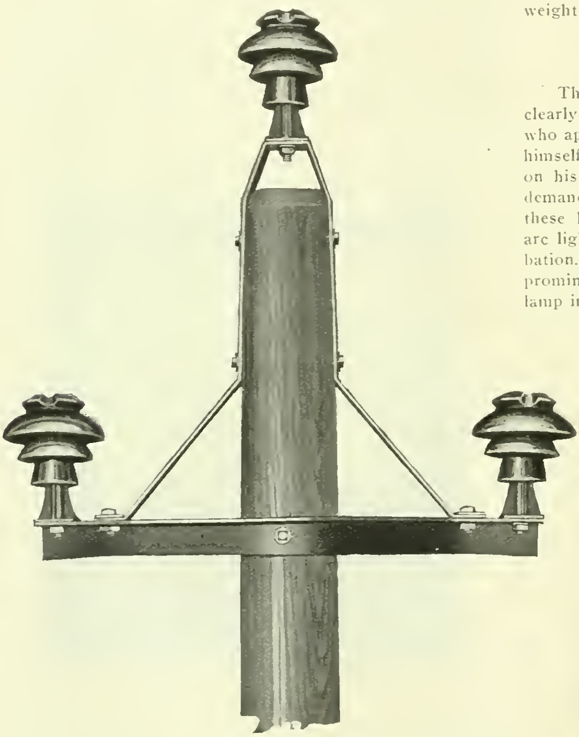
Goliath Crane in Hydro Store Yard.

care of all the loading without assistance. Perhaps the most noteworthy feature of the crane is the gravity lowering device which obviates that "hauling down" of the load which is such a loss of time in the ordinary chain-block. The lowering motion is operated by a light hand chain and is rendered fool-proof by an automatic governor brake which prevents an unsafely rapid descent of the drums. The steel bale is adjustable for width in order to accommodate various sizes of drums. This crane was designed, manufactured and erected by the Herbert Morris Crane & Hoist Company.

The paper insulated lead covered submarine cable to be supplied to Thomas Ross & Son, of Hawkesbury, Ont., by the Canadian British Insulated Company, is to be in two lengths of 2104 feet each. The diameter over the insulation is 2.225 inches and thickness of lead .150 in. The operation of lead covering each length occupied six hours continuous working, the quantity of lead used being 5¼ tons. This is a record length for cables of this diameter.

Keystone Triangle Arms

The Electric Service Supplies Company have placed on the market a new angle iron crossarm to be known as the Keystone Triangle Arm. As will be noted in the illustration it consists of an angle-iron crossarm with braces on either side which are continuous and which form a ridge iron over the top of the pole for a third insulator. The crossarm proper is shaped so as to allow the insulators to be on a line with the centre of the pole and so that braces and top insulator will also be centered. To install a Keystone triangle arm it is only necessary to shave off two sides of the pole at the top so that it will fit the brace, and to bore three holes. The crossarm proper does not require gaining. This small amount of preparation can be very readily and accurately done by means of a templet where a large number of poles are to be erected. On account of the superior bracing qualities of this crossarm it only requires three ¾-inch through bolts to lastingly secure it to the pole. On large installations the minimum time necessary to install these triangle arms should result in some appreciable saving.



New angle-iron cross-arm.

Probably the most important feature of this new crossarm is its great strength and ability to withstand the strain and stress of the heavy lines it is to support. This is particularly true where the pull is downward or at any lower angle therefrom. A careful analysis of the general construction of this crossarm will make this very evident. It is partly due to the equal distribution of weight on either side of the pole, and finally to the exceptional bracing and the improved design and great strength of every part. Other claims made for this crossarm are that the bolts are placed through the pole in opposite directions, giving exceptional rigidity to the installation; that the wires are in a true triangle and all in different vetrical planes, thus decreasing the possibility of a short circuit due to the breaking of an upper wire, which short circuit is quite possible from some of the varied methods now in use for supporting high tension transmission lines; that a maximum height of pole is secured in that the ridge iron is actually an extension to the pole, thereby allowing a shorter pole for a given height of wires. Ground wire supports or bayonets when used in connection with these cross arms are attached by means of the two through bolts which support the upper section of the triangle. They are of the offset type and are made from 3-in. x 3-in. x ¼-in. steel angle. Triangle cross arms are made from 3-in. x 3-in. x ¼-in. steel angle and ¼-in. x 3-in. flat steel. They are made for 3-phase circuits up to 35,000 volts and for 50,000 volt 3-phase circuits. Their approximate weight is 36 and 49 pounds respectively.

Arc Lamp as An Incubator

The adaptability of the immigrant has never been more clearly exemplified than in the case of the English sparrow who apparently under the most adverse circumstances, makes himself thoroughly at home and does not hesitate to poach on his neighbors, be they human or bird, when his wants demand service. The accompanying illustrations show how these bird shave utilized the most modern form of street arc lighting for artificial aid to their natural means of incubation. The pictures show hanging in the streets of a prominent American city, a Westinghouse metallic flame arc lamp into the top of which the sparrows have stuffed a mass of material for a nest. This electric incubator, if it may be so called, has successfully produced three hatchings of sparrows, who, apparently are not at all disturbed by the intense volume of light given off by the lamp or the heat generated at the top where the ventilating orifices are located. They seem to be willing to put up with a little discomfort in order to permit the mother bird to attend the social duties and outings of her kind, of which she would at certain periods otherwise be more or less deprived.

Arc lamp incubator.

It must have been a kind hearted lamp attendant that would permit this accumulation to remain after one hatch-

ing, but it has been found that even where the nests are torn out and the material scattered away from the lamp selected by the colony, it is replaced in a surprisingly short time. A lamp of this type burns from 250 to 300 hours without a

Arc lamp incubator.

renewal of the electrodes, or consequent inspection by the attendant, with the result that at this period of the year an interval of from four to six weeks may elapse between his visits, thus affording ample time for incubation purposes.

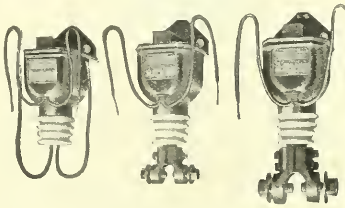
New Weston Instrument Transformers

Two new bulletins announcing and describing switchboard and portable instrument transformers of an exceptionally high order of merit have just been issued by the Weston Electrical Instrument Company, of Newark, N.J. It has of course been recognized that instrument transformers should be designed and made with a much greater degree of refinement than is necessary in commercial lighting and power transformers, and as might have been anticipated these new contributions to the art of electrical measurement by the Weston Company are worthy of recognition as standards of excellence. They represent the results of several years' careful and most thorough analytical study and experimental investigation of the many factors involved

in developing and making instrument transformers capable of giving the highest degree of precision under the widely varying conditions incidental to their practical use.

Two different Models of Portable Current Transformer are listed. One type has three self-contained primary windings and the other is of the inserted primary type, the ratio depending upon the number of turns of the primary that are passed through the aperture. There is also a portable potential transformer which is made in various ranges. The switchboard models are made in several different types which vary in appearance with the ratio, the volt-ampere capacity and with the potential of the circuit.

The manufacturer emphasizes the point that these transformers are unequalled in precision, in design, in workmanship and reliability in service. Indeed, special stress is laid upon the accuracy, the ratios of transformation, and upon the fact that the design and proportions of the transformers are such that it is unnecessary to have instruments specially calibrated with the transformers in order to obtain the degree of accuracy to which high grade instruments are guaranteed when used without transformers. This feature is of



special interest in connection with tests with portable instruments, because in many quarters the impression has prevailed that no transformers could be made that would assure the users of the degree of accuracy for which a high grade portable instrument is designed, unless special precaution had been taken to calibrate a particular instrument with a

particular transformer. The new bulletins are numbered 1501 and 2001, the former dealing with Switchboard Instrument Transformers and the latter with Portable Types.

High Tension Wooden Pole Transmission

The Lindsley Bros. Company are just installing at their pole yard in Nakusp, B.C., a plant for treating the butts of their British Columbia cedar poles. For the past two years this company has been operating a similar plant at Priest River, Idaho, and last year treated over 5,000 poles. This year they have entered orders for over 12,000, their customers including some of the most prominent public service corporations in the United States and Canada, one of them being the municipal electric light plant of Ottawa, Ont. The treatment in this plant, as also in the Nakusp plant, just installed, consists in immersing the butts to a point 12 in. to 18 in. above the ground line in genuine avenerius carbolinium at approximately 200 deg. F. for a period varying from 10 to 20 minutes; the period of immersion varying with the condition of the poles and time of the year. It is found that this immersion is the most efficient and gives a penetration of the entire sapwood of the butt—the only place where decay is likely to affect the pole.

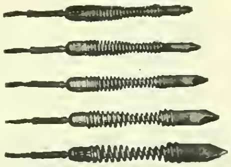
At the present time this company is treating some 7,000 poles for the Great Falls Power Company of Butte, Montana, which will be used in a 100,000 volt transmission line to be erected between Great Falls and Anaconda and designed to carry power for the electrification of the Chicago, Milwaukee and St. Paul Railway. About 4,000 of these poles, which are from 45 to 50 feet long, will be used for the main transmission line which will be of "A" frame construction with six unit, suspension type insulators. This will probably be

the highest voltage transmitted anywhere in the world on wooden poles and is all the more significant as the Grand Falls Power Company have had considerable experience with steel towers. At the present time they have a 60,000 volt line and an 80,000 volt line carried on wooden poles.

Calorized Soldering Iron

Some time ago the Canadian General Electric Company greatly improved their electric soldering iron, both as regards its durability and general efficiency, by the introduction of a heating unit in which the heating material was made of "calorite" wire. This unit was adapted to operate continuously at a maximum heat (that is, running idly) for an almost indefinite period; soldering irons with this type of unit have been run idly for 10,000 hours continuously without noticeable injury to the unit. This company's soldering iron has now been further improved by the discovery of a treatment for copper which provides a copper iron which does not oxidize or corrode; the conducting properties of the copper tube are not impaired, however. This treated copper is named "calorized" copper because of its resistance to the corrosive effects of heat.

The working life of this calorized copper soldering tool is increased, it is claimed, many times over as compared with the old type of soldering iron. The company claim the following features for their new unit.



Varied sizes, soldering irons.

1. Extreme durability of the "calorite" cartridge heating unit (ten thousand hours "running dry").
2. The calorized copper bolt, or tip, which has greatly increased life; the "calorizing" treatment rendering copper non-corrosive.
3. High efficiency, due to the location of the heating unit in the tip.
4. Renewability of copper tip and heating unit.
5. A cool handle, made of metal, and flexible.
6. A detachable cord connector on handle.

Utilize Both Sides of the Street

A suggestion is made in the Lighting Journal that trial installations of street lighting often lose out in the eyes of the public where only one side of the street is lighted—that is, where poles are erected opposite or around a building selected as one suitably located to let the people know what ornamental street lighting will do to "brighten up."

The criticism which has been offered against using but one side of the street is based on the fact that such lighting centres the ordinary citizen's attention too much on the building lighted and at the same time the lighting, as far as the street is concerned, is but half accomplished.

A case of actual experience is cited where posts were put up, properly equipped with lamps, while the public was left to draw its own conclusions—except from the fact that some newspaper advertising was used to back up the campaign. The campaign was a failure and those who were enthusiastic about it had some little difficulty, quite naturally, in finding out what the trouble was. It was perhaps as much a matter of chance as anything that one of the members of the citizens committee who had been pushing the proposition, got an expression from a merchant to the effect that he had driven past the installation in an automobile one night and had drawn the conclusion from the lop-sided exhibition of lighting that the plan involved the lighting of one side of the street only. Such a conclusion seemed hardly believable on the part of those who had supposed they had made their plans foolproof against every possible interpretation of such a nature as was actually drawn by the citizen who had seen only half of the street lighted and so concluded that that was all there was to it—except that it was to be extended along the street on which the building faced.

The conclusion drawn from this particular experience at any rate, in the community where it so failed as to make it seem unfeasible to try it again, for some time to come anyway, was that if an exhibition is to be made of street lighting it should be made of sufficient completeness to give the most unimaginative citizen a very definite idea as to what the street will look like when everything is completed.

Obituary

Mr. Roderick J. Parke died at his home, 179 Cottingham Street, Toronto, on August 25th. He had been ill for some time and his death was not unexpected. Mr. Parke was born in Cornwall, Ont., but has resided in Toronto for some 15 years, where he was probably best known through his connection with the firm of Parke & Leith, Canadian agents for the British Aluminum Company. A couple of years ago Mr. Parke resigned from this partnership to take up consulting engineering work and later accepted the position of managing director of the Automatic Electric Cook Company. He was an associate member of the Canadian Society of Civil Engineers.

Large Stock of Motors on Hand

The Ferranti Electrical Company of Canada announce that they are in receipt of a large stock of standard motors from the Bruce Peebles Company which shipment arrived only a day or two before war was declared between England and Germany.

It is encouraging to note that Tramways, Limited, the company which proposes to build the inter-urban line in the Edmonton district, announce that they are prepared to proceed with the project as soon as arrangements can be finally completed by the city council. It was feared that the money for the undertaking would not be forthcoming, but this idea has been dispelled by definite assurance from New York city. It is expected that the firm will employ about three hundred men and eighty teams at the outset.

J. D. Lachapelle & Company announce that they have recently been appointed sole Canadian representatives for the Morey Flux & Chemical Company, of Parkesburg, Pa., who specialize in the manufacture of welding material and welding flux as well as chemicals used for this purpose. This welding material and flux are used for electric arc welding, axy-acetylene welding, and gas welding of all descriptions.

Mr. C. H. Rust, city engineer of Victoria, was in Vancouver recently conferring with Mr. G. R. G. Conway, chief engineer of the British Columbia Electric Railway Company, respecting the Johnson Street bridge at Victoria. The railway company wish to have the plans of the structure altered to meet the requirements of their heavy electric locomotives. The additional cost will not exceed $50,000.

Reduce Price September 1

The Onward Manufacturing Company, of Berlin, announce that they are reducing the price of their Eureka machine to the extent of $5.50. The new price takes effect on September 1.

New Companies

The Montcalm Electric & Manufacturing Company, Limited, has been incorporated with a capital of $99,000 and head office Rawdon, Quebec.

The New Glasgow Electric Manufacturing Company, Limited, has been incorporated with capital stock $99,000 and head office New Glasgow, Que.

The Forbes Electric Company, Limited, has been incorporated with head office Saskatoon. Capital is $10,000.

Trade Publications

Electra—Folder issued by the Canadian General Electric Company describing Electra carbons for moving picture machines.

Welding Materials—Small booklet issued by the Morey Flux & Chemical Company, Parkesburg, Pa., describing welding material, welding flux and chemicals as manufactured by this company.

Railway Motors Gears and Pinions—Bulletin No. A4199 issued by the Canadian General Electric Company. Well illustrated and contains much interesting information on the subject of gears and pinions.

Protection—Folder issued by the Railway & Industrial Engineering Company, Greenburg, Pa., describing the Burke series horn-gap lightning arrester. The Ferranti Electrical Company of Canada are Canadian representatives.

Work Done—A publication issued by Westinghouse, Church, Kerr & Company, of New York, describing with illustrations a few of the industrial installations recently carried out by this firm of engineers and constructors.

Electricity in Coal Mines—Bulletin No. 48011 issued by the Canadian General Electric Company illustrating and describing at length suitable machinery, and a number of actual installations showing the application of electricity to the mining of coal.

Trolley Guards—Folder issued by the Ohio Brass Company, Mansfield, Ohio, describing and illustrating National Railroad Trolley Guard of which this company claims there is now over 100,000 feet in service protecting grade crossings on many prominent roads.

Badger Engines—For gas, gasoline, or kerosene, are described in a catalogue issued by Canadian Allis-Chalmers, Limited. These engines are made in sizes from 2½ to 30 h.p. and are particularly well adapted for isolated electric plants. They are built by the Christensen Engineering Company.

"Advertising that helps you Sell," a bound collection of advertisements placed in popular magazines by the Westinghouse Electric & Manufacturing Company. The pamphlet includes advertisements of domestic and industrial applications of electricity and is being distributed to central stations and dealers to inform them of the service furnished by this company.

"The Young Man and the Electrical Industry"—A story written by James H. Collins, the well-known magazine writer, which has just been issued by the Westinghouse Electric & Manufacturing Company. The little book deals with the opportunities afforded a young man in this industry and the different lines in which he may direct his activities as exemplified by the works of the Westinghouse company. This company announce that they will supply a copy to anyone interested in the development of young men.

Current News and Notes

Comber, Ont.

The ratepayers unanimously carried a by-law to raise $4,500 for a distribution plant and to close an agreement for a power supply with the Hydro-electric Power Commission of Ontario.

Dartmouth, N.S.

The Dartmouth & Cow Bay Electric Railway has received an extension of time on its franchise from the Nova Scotia Legislature to build this projected railway from Dartmouth to Cow Bay Beach, Halifax County, N.S.

Fort William, Ont.

Plans of the new sub-station installation have been received from the Hydro-electric Power Commission of Ontario, and the Canadian General Electric Company have been requested to rush work on the new motor-generator.

Galt, Ont.

A contract has been signed by the Canadian Cereal Company for 250 h.p. of electric energy. This is said to be the largest contract yet signed by Galt for hydro power. A number of motors are being purchased by the Cereal Company from the Canadian General Electric Company.

Montreal, Que.

Under the sale by auction on September 22 of the main assets of the East Canada Power and Pulp Company, Limited, Murray Bay, P.Q., and of shares and bonds of the Labrador Electric and Pulp Company, the liquidator will dispose of the benefits and obligations with respect to lighting contracts now existing.

Earnings of the Shawinigan Water and Power Company continue to show increases. For the month of July the total was $141,992, a gain of $6,726 over July, 1913, and $37,892 higher than in the same month two years ago. Up to the end of July this year the earnings were $992,264, an increase of $57,835 as compared with the seven months of 1913 and of $274,308 as compared with the same period in 1912.

The Cedars Rapids Manufacturing & Power Company have placed an order for three car loads of special large cross-arms for their main transmission line. These are to be of British Columbia fir and will be supplied by the Barnes-Lindsley Company, of Portland, Oregon, through their Canadian agent, J. D. Lachapelle & Company. These cross-arms are to be treated with avenarious carbolinium.

Tenders have been received by the board of commissioners for the installation of certain underground cables for the fire alarm department.

Ottawa, Ont.

An Order in Council was recently passed requiring that all electrical installations in all Dominion parks must be in accordance with a set of rules and regulations based on those of the Hydro-electric Power Commission of Ontario. These rules and regulations are printed in the official government gazette.

Owen Sound, Ont.

The Hydro-electric Power Commission of Ontario are calling tenders for the purchase of timber and the clearing of timber and swamp lands in the vicinity of Eugenia Falls.

Regina, Sask.

The following telephone companies have been incorporated in Saskatchewan:—Bennett Rural Telephone Company, Limited, Craik; Deep Lake Rural Telephone Company, Limited, Indian Head; Lewiswyn Rural Telephone Company, Limited, Raymore; Earnscliff Rural Telephone Company, Limited, Ellisboro; Glenavon Rural Telephone Company, Ltd., Glenavon; Foxbury Rural Telephone Co., Limited, Craik; Crescent View Rural Telephone Company, Limited, Hantley; Success Rural Telephone Company, Limited, Melville; Saskatchewan River Rural Telephone Company, Limited, Outlook; Cedoux Rural Telephone Company, Limited, Cedoux; Dewey Rural Telephone Company, Limited, Macoun; Paswegin Rural Telephone Company, Limited, Paswegin; Willow Hill Rural Telephone Company, Limited, Davidson; Butterton Rural Telephone Company, Limited, Butterton; South Melfort Rural Telephone Company, Limited, Melfort; Belvidere Rural Telephone Company, Limited, Cantuar; Osage Telephone Company, Osage.

The operation returns of the municipal electric railway, Regina, for the week ending August 8th, are as follows. Revenue, $3,980.70; passengers carried, 92,059.

St. John, N.B.

A submarine telephone cable has just been laid between East and West St. John by the New Brunswick Telephone Company. This is a 60 pair cable something over 2,000 feet in length. Up to the present time telephone connection between East and West St. John has been by way of the suspension bridge.

The St. John Railway Company have received two new cars for addition to their rolling stock.

Shoal Lake, Man.

In connection with the new electric light plant to be installed in Shoal Lake a contract has been awarded to the Accumulator Lighting Company, Limited, of Winnipeg, for a 120-cell storage battery equipment which will carry the load at off-peak hours.

Toronto, Ont.

The date on which the vote will be taken in the different municipalities on the question of a municipal electric railway service through the Markham, Port Perry and Uxbridge district has been extended one month from September 21 to October 19. The somewhat unsettled condition of the electorate and the difficulty of procuring speakers during the past two or three weeks has rendered this postponement necessary.

The Board of Control has asked the local hydro-electric commission to rush work on their large transformer pits as these constitute considerable obstructions in the business sections of the city.

Valcartier, Que.

The military camp at Valcartier is being supplied with water by duplicate electrically driven pumps having a capacity of 80,000 gallons per hour. Pipes are being laid over the camp ground for a general water supply.

Walkerville, Ont.

It is announced that negotiations have been completed for the purchase by the municipality of the plant of the Walkerville Light & Power Company. This will be utilized in connection with Niagara power soon to be delivered over the high tension line of the Hydro-electric Power Commission of Otnario.

Winnipeg, Man.

Plans are being prepared by the Winnipeg, Selkirk & Lake Winnipeg Railway Company, a subsidiary of the Winnipeg Electric Railway Company, for a new sub-station at Stony Mountain.

Electrical News

Generation, Transmission and Application of Electricity

Published Semi-Monthly By

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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"Fix Up" Around the Power House

An interesting communication comes from Woodstock, Ont., that "the local Hydro-Electric Commission are co-operating with the Southside Park Commission in **fixing up the grounds around the Hydro power house.**"

This is a form of co-operation that may well be developed in many other towns in Canada. Woodstock is by no means an isolated case where the power house needs the surrounding grounds "fixed up." Indeed, our recollection is that the Hydro Commission in Woodstock have paid more than usual attention to the attractiveness of their property, both as regards the buildings and their surroundings. We wish the same could be said of other municipalities. As we pointed out in a previous article, there is very great need for an improvement in the architectural design of our power buildings and sub-stations, and it follows quite naturally that a proper care of the grounds surrounding these buildings is as important as the architectural design of the buildings themselves. This fact does not appear to be universally recognized, or, if recognized, is ignored often for many years after a plant has been in operation. It is no unusual thing to see an expensive power house or sub-station building, boasting more or less of an artistic and pleasing exterior, surrounded by piles of excavated earth overgrown with thistles and weeds and rendered still further unbeautiful by the remnants of various kinds of building material, which have been left lying around, or leaning against the new building. Woodstock is fortunate, first, in that they have a park commission who are interested in rendering the city attractive, and still more fortunate in that they have a hydro-electric commission who are appreciative of the value of this work. Electricity in its every application is so fully recognized as tending to elevate and educate the general public, that it is surely a great pity that the building from which this electric energy is sent out should be one of the greatest eyesores in the whole community. We trust that Woodstock's example will be noted by many other municipalities, and that gradually these power houses will be made the centres of the beauty as well as of the power of the municipality.

For the Good of the Service

A Canadian company well-known for its aggressive tactics and efficient service, make a very strong bid for the citizens' patronage by publishing a list of a large number of Canadian and foreign associations and societies in which this company is represented by membership. It is claimed that through attending the meetings of these associations, acting as officials of some of them, reading and studying their papers and taking part in their discussions, and by constant study of the different technical and commercial periodicals and other literature devoted to the electrical and allied arts, the members of this company's staff keep abreast of the developments of the times and acquire knowledge that enables the company to serve the public as it should be served.

We believe the point is excellently taken and that the policy of this company might well be followed to a much greater extent than is the case at the present time by many other companies in Canada. The rapid advances in methods of design, installation and service have been so great during the last five years that no company which has not kept in close touch with these advances can claim to be giving a modern or entirely satisfactory service. The list of the associations, which we are publishing below, is of course unnecessarily large for the average central station, but it just indicates the determination of this particular company to have everything that is worth having. No doubt a list of periodicals studied by this company's officers and employees would be equally complete. A list of the associations and societies follows: Canadian Electrical Association, Canadian Society of Civil Engineers, Engineers' Club of Toronto, Central Railway and Engineering Club of Canada, Institution of Electrical Engineers, Great Britain, Verein Deutsche Electrotechniker, Gesellschaft Ehemaliger Polytechniker, Zurich, Reichsverein der Oesterreichischen Privatbeamten, American Institute of Electrical Engineers (Fellow), American Society of Mechanical Engineers (Member), National Electric Light Association, United States, American Electric Railway Association, Engineers' Club, New York, New York Railroad Club, Electric Vehicle Association of America, Illuminating Engineering Society, United States, Society for Electrical Development, Sons of Jove.

The Lowest Canadian Rates

The Hydro-Electric Power Commission of Ontario have authorized the following rates in Galt:—

Domestic rate: a floor area charge of 3 cents per 100 sq. ft. with a minimum of 1,000 sq. ft. and a maximum of 3,000 sq. ft.; discount of 10 per cent. for prompt payment. To this is added a meter rate of 2½ cents per kw.h. with 10 per cent. discount.

Commercial rate: 6 cents per kw.h. for the first 30 hours use of connected load; 2½ cents per kw.h. for all additional consumption, with a minimum charge of 50 cents; 10 per cent. discount for prompt payment.

These new rates for Galt are probably as low as, if not a shade lower than, the rates given by any other Hydro town.

With the 10 per cent. discount, the net rate is 2.7 cents per 100 sq. ft. of floor space, and 2.25 cents per kw.h. The only rates which may be said to compete with Galt are those given in St. Thomas and Ottawa, where the net rate is 3.2 cents per 100 sq. ft. of floor space and 2 cents per kw.h. Which of these rates would work out the better would depend on the area charge. Other towns in the running are Port Arthur, with net rates of 3.6 and 2.25 respectively; London, with 3 and 2.25; and Preston, with 3.2 and 3.2. It is worthy of notice that the commission at last finds itself able to break through the 4 cent flat rate, which has been maintained so uniformly up to the present time. Galt is, we understand, the only Hydro town which, as yet, charges less than 4 cents gross per 100 sq. ft. of floor space.

Ten Good Reasons for Using "The Electric"

The Electric Vehicle Association of America has prepared a very attractive three-colored four-page inexpensive pamphlet, pointing out the value of the electric passenger vehicle for business and pleasure. The text, which has been made terse and informative, is herewith indicated:—

Speed: More than you can use in the city—all you'll ever require in the country—the Electric is as adaptable in its range of speed as any other type of car.

Power: Real hill-climbing ability. The electric vehicle will travel 50, 75, 100 or more miles per charge according to battery equipment.

Charging: Press a button—the rest is largely automatic. Simplicity itself and absolutely clean. Batteries can be charged with large amount of current in a short time or a small amount in a longer time (over night when not in use). For instance, if touring, batteries can be charged while you are at luncheon.

Garaging: At home? Yes! And simple and clean. At public garages (look for official garage and charging stations signs of the Electric Vehicle Association) excellent and inexpensive service may readily be obtained.

Economy: Mile for mile, all things considered, the electric vehicle is the cheapest car to run. Its low operating costs will be a pleasant surprise for you.

Tires: The electric vehicle is easy on the roads—therefore easy on tires. Its tire costs are comparatively insignificant.

Reliability: You will depend on the electric vehicle for it is worthy of your confidence—it will not fail you.

Distinction: The character of the electric vehicle is an expression of good taste.

Usage: The electric passenger vehicle is primarily a business car as used by doctors, salesmen, merchants, etc., but its ease of control; freedom from dirt and noise; smooth, easy riding qualities and reliability, have made it a great favorite with milady for shopping, visiting and touring.

Resume: The principles of electric vehicle design are founded on those developed in the electric railway; and their reliability and simplicity are on a par with the street, elevated and subway cars on which we so greatly depend.

The last page is arranged for an attractive imprint of the concern circularizing same.

Electricity at the Canadian National

As usual the electrical exhibit at the Canadian National is one of its most attractive features. Unfortunately, provision has not yet been made for housing all the electricai equipment in an "Electric Building," but as far as possible the electrical machinery has all been grouped together so that the visitor can form a fairly comprehensive idea of the magnitude of this industry. The most startling advance of the year has been, of course, the introduction of the nitrogen-filled lamp, which very few of the visitors outside of our larger cities and towns have seen before attending this display. For the rest, the exhibits show advances in refinements of manufacture and better consumption efficiency rather than in the introduction of new equipment. It is very noticeable too that the average visitor has become accustomed to electrical equipments and shows by his intelligent questions and remarks that he appreciates more fully their convenience and usefulness. This is the gratifying result of the educational campaign that has been carried on all over the Dominion during the last two or three years, with a view to showing what the possibilities of household electrical equipment are. That the exhibits at the Canadian National Exhibition have played a large part in this campaign of education there is no reason to doubt.

There is little sign, if any, that the unsettled financial and industrial conditions caused by the great European war have had any depressing effect on the Exhibition proceedings. In the electrical industry the exhibits are quite up to standard both in number, size and quality. We mention a few of the more important below, with a very brief comment on each.

Jefferson Glass Company—This is a Toronto firm, manufacturing lighting glassware of all kinds. Their very attractive exhibit indicated the various ways in which their Moonstone ware may be utilized for effective illumination.

Northern Electric Company, Limited, exhibited all kinds of electrical supplies, including telephones, heating appliances, electric wire and cables, vacuum cleaners, etc. This exhibit was very artistically arranged and was one of the most attractive to be seen at the exhibition.

National Electric Heating Company—A Toronto firm, manufacturing electric heating appliances. The exhibits included irons, toasters, heaters, disc stoves, and the attractive new range recently placed on the market. Household cooking utensils of all kinds were also shown, the range of this company's manufacture being very complete.

Renfrew Electric Manufacturing Company, Limited—This company manufactures in Renfrew, Ontario, a complete line of the smaller electrical appliances. Their exhibit was particularly given over to the display of a wide range of all kinds of electrical heating appliances, including irons, hot plates, disc stoves, toasters, coffee percolators, ranges, heaters, etc.

British Aluminium Company, Toronto—This exhibit was designed to emphasize the various electrical applications of aluminium. Samples of aluminium cable of all the usual sizes were shown, some of these attached to insulators to demonstrate methods of tying on and clamping. Methods were also shown of splicing and jointing. One or two specimens of lead-covered paper insulated aluminium cables for underground use were also shown. Not the least interesting part of this exhibit was a group of series field coils wound with oxidized aluminium wire without insulation.

R. A. Lister & Company, Toronto—This company is best known for their automatic electric lighting sets, a very large number of which have been installed at various points in Ontario. They are especially suitable for hotels, hospitals, country homes or villages, and consist of an engine, a generator, switchboard and set of storage batteries. Where gas is desired to be used and is not available, producer equipment is also supplied, though gasoline engines are quite satisfactory. Their exhibit showed one of these sets in operation.

The Canadian Independent Telephone Company Toronto, had as usual a very attractive exhibit of telephones and supplementary supplies. The exhibit included the Prestophone, a type of intercommunicating instrument specialized in by this company.

W. H. Banfield & Sons, manufacturers of fixture parts and fittings, Toronto, displayed a variety of their many

types of chain; also fixture parts in different stages of manufacture.

Tallman Brass & Metal Company, Hamilton—This company had an exceptionally artistic display of many handsome designs of electric fixtures, including showers, clusters, pendants, chandeliers, etc. This firm has made wonderful progress in this line, which was inaugurated only a little over a year ago. Their display was exceedingly attractive and complete.

Tuec Vacuum Cleaners—demonstrated by Mr. J. J. Martindale, Toronto, the Canadian agent. This cleaner is of the stationary type, and is adapted for large residences and public buildings of every kind. The Tuec was shown in operation.

The Jones & Moore Electric Company as usual were featuring Century motors in many different sizes. Another feature exhibited by this company was the Pelouze line of heating appliances of various sorts.

The Toronto Electric Light Company displayed a number of economical and up-to-date pieces of electrical apparatus in operation.

The Toronto Hydro-Electric System showed various household electrical appliances operated.

The Stromberg-Carlson Telephone Manufacturing Company showed their usual interesting exhibit of telephones and supplies.

The Norton Telephone Company displayed a complete line of intercommunicating telephones and supplies.

Lintz-Porter Company—An electrical contracting firm with Toronto offices. Their display consisted of a very interesting exhibit of intercommunicating telephones and electric signal systems.

The James Morrison Brass Manufacturing Company had an exhibit which created a great deal of interest in its variety and tasteful designs of electric lighting fixtures, particularly for household use.

The Crown Electrical Manufacturing Company, Brantford, exhibited a complete line of electric lighting fixtures.

The Ontario Art Brass Company, Toronto, had a very complete display of electric lighting fixtures.

The Radiant Electric Manufacturing Company, Grimsby, had their usual complete line of electric heating and cooking appliances.

The Canadian Hotpoint Electric Heating Company—Electric heating and cooking appliances.

E. W. F. Salisbury—Electric fixtures and shades.

The Consolidated Electric Company—An exhibit of considerable interest with "King Edward" motors as the chief attraction.

Cummer-Dowswell, Limited—Electric washing machines.

The Patent Situation

We have received the following communications regarding the present patent situation, which is important in view of many misconceptions which have arisen since the war began. As more is known of this situation abroad, we shall keep our readers advised.

Editor Electrical News,
Toronto

Dear Sir:

The present war has naturally materially interfered with patent practice on the European continent, and some time yet must elapse before points in doubt can be settled. We are, however, just in receipt of information from abroad of much importance to Canadian inventors or owners of continental patents.

France has suspended indefinitely the requirement for the payment of taxes on French patents so that all patents will remain valid until a future date, which will be set by special decree, on which all arrears of taxes must be paid.

The German office has provided a general extension of time for three months from the first of August last for the filing of amendments to pending applications. This appears like a sublime confidence on the part of Germans in a short and successful campaign. Canadians having patent applications pending in Germany will not suffer, for the present at least, by the inability of their attorneys to do business in Germany, and if the war continues further relief may be given.

The stories of the confiscation of British patents held by Germans and Austrians seem to be untrue. We have no official advices to that effect. It is not a probable course of action, as a government has the right to use any patented inventions it may need and also the right to set the compensation, but as the citizens of a country with which we are at war have no legal status in our courts, infringement would necessarily go unpunished.

It will still be possible to do business with any European country with which we are not at war, but communication with such countries may be subject at times to delay.

Yours truly,

Ridout & Maybee.

Toronto, Sept. 3.

Editor, Electrical News:

Dear Sir:—Since writing you our letter of September 3rd in regard to patents, we are in receipt of further advices from Great Britain.

Patents and trade marks granted to a subject of any state with which Great Britain is at war are not declared to be void, but may be voided or suspended in whole or in part on application to the Board of Trade. The applicant must put up a fee of two pounds with the application, and a fee of half a crown for depositing foreign documents or other papers for purposes of record. The Board of Trade may then suspend or void the patent in whole or in part if it appears that the person applying intends to manufacture the invention and if it appears to be in the general interest of the country or a section of the community or of a trade that such article should be manufactured or any process carried on. The Board of Trade may at any time in their discretion order the voidance or suspension in whole or in part of any patent as they may see fit without special application being made to them. It remains to be seen to what extent these provisions are taken advantage of.

Yours truly,

Ridout & Maybee.

Toronto, Sept. 10

Lightning Arresters

Editor Electrical News,
Toronto

Dear Sir:

I enclose a short article in reply to the article published on Aluminium Cell Arresters in the "Electrical News" of August 15th. I would esteem it a favor if you could see your way clear to publish same, as, although I do not wish to comment on the aluminium cell arrester, I think the opinions, conclusions, etc., coincide remarkably with those given by the Moscicki Company, some five or six years ago, and which statements were then received more or less doubtfully.

Yours faithfully,

N. W. Lofvengren.

MR. LOFVENGREN'S VIEWPOINT

In a recent article on Aluminum Cell Arresters, published in the "Electrical News" of August 15, 1914, page 44, opin-

ions were given by possibly the most eminent engineers on the subject on this continent (Messrs. Steinmetz, Creighton, etc.).

Whilst not commenting in any way as regards their conclusions on the merits of the Aluminum Cell Arresters, the writer would point out a few remarks, conclusions, etc., the results of the very latest practice and recent experiments, which coincide remarkably with statements published by The Moscicki Company over five years ago.

Frequency and Shape of Surge (Steep Wave Fronts)

Mr. Creighton says: "It has been possible to say that if future investigations of cloud lightning prove that every lightning stroke is of high frequency and steep wave front, certain changes would come about under these conditions. . . . . The natural growth of protection would be along the line of various types of high frequency absorbers. . . . . Recent investigations of lightning phenomena have confirmed our views that cloud lightning has wave fronts of various degrees of steepness. . . . . That the frequency might be from zero to 5,000,000 cycles per second."

Mr. Peek says: " . . . . High energy lightning discharges of moderately steep wave fronts or moderate frequency. This is often the only condition. . . . . There are certain conditions, generally in the minority, which occasionally on a few systems are the prevailing ones, which no arrester with a gap can, unaided, satisfactorily take care of. These conditions are:

1. Lightning impulses of exceedingly steep wave front and high voltages.
2. Impressed high frequency of a voltage insufficient to discharge the gap."

Mr. Mailloux says: " . . . . It would seem, therefore, as if one might expect that the character of the wave-front would depend somewhat upon the distance from the apparatus at which the lightning strikes the line. One might expect that the lightning striking the line very close to the lightning arresters would produce a current-wave having a squarer straighter front, a more vertical one, than if it struck at some distance, owing to the difference in line reactance."

Mr. Steinmetz says: " . . . . Any disturbance of a voltage less than that which will jump the gap and thus reach the aluminum cells naturally cannot be absorbed by the aluminum cells. Therefore, if we have a high-freqency oscillation of a voltage sufficiently low not to jump the spark gap and incidentally sufficiently not to do any damage to the line, such a voltage may not be able to do harm to the insulation from line to ground, but when massing of the surge occurs in a few turns of reactance such as a single coil of a transformer, it may do very great damage because, while the apparatus is designed to stand the line voltage, it is not designed to stand half the line voltage across say one-hundredth or one-thirtieth of the circuit. The main trouble, due to high frequency, comes from the local massing of voltage across the reactance. In speaking of high frequency, we may refer to various different effects, and we also usually mean a thing which is not high frequency at all, is not even oscillation—it is steep wave front. A steep wave front, to some extent, causes the same trouble, namely the same massing of voltage, but in other respects it is very different."

The above opinions can be taken as reasonably conclusive proof that the danger from "lightning," or as we would prefer to say from "atmospheric disturbances of an external nature," is due to high frequency or steep wave fronts, and we would point out that in the publications on the Moscicki apparatus, this point is particularly emphasized. On page 19 of the 1910 publication the following statement appears:—"This leads us to the important conclusion that high frequency surges of 2,000 or 3,000 volts are able to perforate a transformer designed for 50,000." There is further given a mathematical proof that the amount or length of winding affected is not serious in the case of low or medium frequencies, but becomes very dangerous in the case of high frequencies, and also show the comparative values of a bye path (a so-called lightning arrester) with the system itself and prove the impossibility of an effective bye path based on a resistance principle, since if one makes the path so low in resistance as to be effective in protection, one permits a condition to exist that may possibly create the surges we wish to avoid.

The Principle of a Protective Apparatus

Mr. Steinmetz says: " . . . . Electrostatic capacity is not a lightning protective device—is not by itself a protection. . . . . The favourable action the condenser can have is apparently to short-circuit disturbances of relatively high frequency. . . . . The value of capacity in protective devices lies in the fact that it is a barrier against the passage of current at machine frequency without being a barrier to the passage of surge currents which are inherently of high frequency."

Mr. Peek says: "The dielectric breakdown time lag of the gap may prevent discharge of the arrester before discharge takes place at some weak point in the system. The discharge does not take place at the gap because the voltage is not high enough, but the oscillations may build up high voltages internally in an apparatus containing inductance and capacity."

All the publications on Moscicki condensers clearly demonstrate the danger to windings due to "the massing of voltage between turns" on the occasion of a high-frequency oscillation. They further show mathematically the value of a condenser between the terminals of the transformer or machine and earth, thus "short circuiting disturbances of relative high frequency," but not in any way affecting line current. It is not claimed that the Moscicki condenser dissipates energy, but it is claimed to so affect the shape of the high frequency surge, as to flatten it out, absolutely preventing dangerous conditions on the system, and so absorbing the shock, performing a somewhat similar function as does the gas bag to a gas engine.

The Operation of Electrolytic Arresters

Various remarks have been made regarding the characteristics of the aluminum cell arrester. On page 44 Mr. Creighton says: " . . . . The discharge rate at double potential is more than a million times as great as the leakage at normal potential." Though this be the case, we do not see that there is any advantage in having a leakage current at all, and the most perfect apparatus of course would have no leakage at a normal voltage and frequency.

Again, it is said: " . . . . The higher protection given by the cells would justify some increase in expense on account of the better service that can be maintained. . . . . . When the number of arresters in use ran up into the thousands, then an occasional trouble resulted from the rush of current into the aluminum cells. The aluminum cells are condensers and as such will take initially a considerable rush of current. Furthermore, the dissolution of the aluminum films required a considerable quantity of electricity from the line to reform them. Where the films had been subjected to unusual dissolutions, either by standing in hot electrolyte, resulting from atmospheric temperature or long periods of discharging, or from neglect to charge, the current rush into the aluminum cells became a serious menace, mostly to the arrester itself. Since there is no external indication of a bad condition of the aluminum cells, even an expert would be unable to know if it were permissible to close the charging gap of the arresters. This led naturally to the use of charging resistances in series during the ten

seconds a day needed to charge the arrester. The charging resistance is an added expense and an added complication . . . . bad regulation of a line in which the power voltage is allowed to rise to values above the spark potential of the arrester. Under these conditions of discharge the arrester is no longer being used as such, but rather as a rheostat to absorb the generated power. The arresters cannot at any reasonable expense be designed to act as rheostats. . . . . . Certain kinds of impurities have a strong destructive effect on the films. A condition of unusually high operating temperature may call for an electrolyte especially adapted to high temperatures, or it may simply be taken care of by charging two or more times a day. Dissolution of the film from standing in hot electrolyte after the arrester has discharged continuously for a number of minutes can cause no trouble if a reasonable charging resistance is used, as the series resistance limits the current to a value which will not damage the arrester. With the exception, then, of high generator potentials from bad regulation of voltage, there is no difficult problem connected with the use of aluminum arresters."

All these characteristics of operation, etc., certainly do not add to the advantage of the aluminum cell arrester, and though means may be evolved to overcome these various disadvantages and permit of more or less reliable operation, an apparatus such as the Moscicki condenser, in which these disadvantages do not occur, is of course to be preferred. The effect of possible trouble is not by any means advantageous to any apparatus.

Are Arresters Required?

Mr. Creighton, on page 51, says: " . . . . Since the factor of safety of the insulators was about 10, they were not functioning as lightning arresters or protectors for the apparatus, and consequently every lightning stroke that appeared on the line came with horrible impetus into the station. Switch bushings, transformer bushings and other insulation that had withstood the conditions of other circuits, immediately began to break down from flash-over or by puncture. Lightning arresters of the best type were then required. This is a condition that is gradually growing all over the country. Everywhere operators find that insulation on the line is an important factor, and are increasing the factor of safety in the line insulators. Personally, I would never use a factor less than three times normal potential, preferably still higher. The extra investment in insulators is worth while. This ultimately necessary practise will increase the need of lightning arresters."

And this very clearly explains the value of arresters on a system.

Seeing that the various opinions, etc., expressed above coincide so clearly with those given by the Moscicki Company, and that their apparatus has been particularly designed to meet these conditions and afford protection from the phenomena mentioned, it would seem that the Moscicki designs are more nearly a step in the right direction for the elimination of lightning troubles than the various other apparatus.

This is also borne out in practice, as, in localities where the Moscicki apparatus has been installed, in every case highly efficient service has been rendered, and the protection obtained far superior to that of any other scheme, there being no leakage current under normal conditions, no periodical forming, and therefore no possibilities of danger from the human element.

The engineering staff of the Montreal Harbor Board is engaged on plans for an electrical railway to replace the present steam line which runs along the harbor front. It will be an elevated line. Construction work will not be commenced until next season.

Opportunities for Sales Engineers

By S. L. Nicholson*

Various classes of engineering services are required by a large electric manufacturing company. The research engineer delves into compositions of materials and theoretical considerations and must be of an analytical turn of mind. The designing engineer must be able to design apparatus and supplies to meet certain definite requirements at a minimum cost; that is, he must be able to design apparatus which can be sold at the regular market price and at a profit for the company. Engineers are also required for testing and supervising the erection of apparatus.

Just now a comparatively new type of engineering presents great opportunities; viz., application engineering salesmanship. The field of activity is almost unlimited, as it has to do with the application and uses of electricity in connection with practically all the ramifications of industry. The application engineering salesman should have a knowledge of both electrical and mechanical engineering; he must understand what results are obtainable. He must be proficient in sales work from the standpoint of understanding commercial conditions. He must be responsible (considering one phase of the work) for the electrical development and laying out of power houses, transmission lines and railway work. He must be able to co-operate with the other engineers in making up plans and estimates of specific layouts and he must also be sufficiently commercial to interest bankers in his new projects. In another type of application engineering the engineer is responsible for the development of an industry, and in this case he must be also a process engineer; he must understand factory methods and be able to propose improvements by the use of electric power; he must be able to apply existing apparatus to the field conditions in such a manner as to produce a profit for the investor.

Another class of engineering is taken care of by the consulting engineer who must have a broad experience and should be an application engineer as well as somewhat of a designing engineer.

In order to apply engineering to sales work so that the relation between the two may be understood readily it will be well to outline the various classes of men engaged in an electric sales organization. The negotiation salesman is found largely in the central station or railway work. He has perhaps comparatively little knowledge of pure engineering theory (his plans can be worked up in detail by the application or designing engineer), but he must be of the promoter type, that is, he should be able to see opportunities for development in water-power sites, etc. Bearing in mind the community needs, he should be able to interest the bankers so that the undertaking can be properly financed, and he must be able to translate engineering terms into the language which non-technical men can understand. The old method of selling, via the stomach, has given away to service selling by the promoting engineer.

The electrical engineering salesman who is found in the railway, lighting and supply departments, must know the design of his apparatus in such a way as to be able to present to the customer the best arrangement of apparatus to suit his needs.

The application salesman is found principally in industrial and power work, and to a lesser degree in the illumination and railway fields.

The merchandising salesman has to do almost entirely with the merchandising of commodities through dealers, jobbers, etc. He must be familiar with price situations and methods of distribution and must be able to create a demand

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for his product. His work consists largely in creative salesmanship.

It will perhaps be advisable to outline some of the functions of the sales department. First, is the laying out of new central station plants and railway systems, which is a function of negotiation and electrical engineering salesman. Consideration must be given to the capacity of stations, the size of generators, the requirements of transmission lines, and the conditions in railway service. This work requires a great deal of co-operation with consulting engineers. Next, is the revamping of old plants, in which the application engineer studies how to use the latest devices to increase output or to economize in operation so as to increase earning capacity. He must make friends and be able to create confidence by getting into close touch with the customer.

The application of motors to various industries requires a high type of engineering and provides a wide field of opportunity. Motors are sold for complete plants to increase output, to reduce cost or to better the product. To determine how to do these things is the study of the application engineering salesman. There must also be an outlet for apparatus through the re-sale trade, such as to machine-tool builders, and the manufacturers of centrifugal pumps, elevators, etc., who purchase motors to be sold again. Since these buyers are mechanical rather than electrical engineers, the salesman must be both an electrical and mechanical engineer. Ten years ago the tool builders fought electric drive. Electrical salesmen showed that by strengthening the tool rest of an 18-inch lathe and applying an adjustable speed motor, the lathe could be sold for a higher price by basing the guarantees on the amount of metal that could be cut in a given time. The wide range of speed control of electric motors became an important factor in enabling efficient use of high speed tool steel to be made. It became necessary to study torque conditions in order to determine the proper motor to apply. For example, in raising the head of a boring mill, where formerly a two horse-power motor was used, a three-quarter horse-power motor is now furnished and 300 per cent. full-load torque is required for short intervals of operation. The activity of these men in applying electrical equipment to complete plants and to the re-sale trade results in increasing the central station loads.

The services of a few electrical engineering salesmen are required in the sale of transformers, regulators, reactance coils, meters, etc., to central stations. Switchboard engineers, located in the larger sales offices, design switchboards for specific cases out in the field and send the specifications to the factory. Other salesmen study conditions for the application of heating devices for various industrial purposes.

The necessary qualifications of an application engineering salesman may be briefly indicated. He must be able to analyze conditions carefully from an engineering and economic standpoint and draw conclusions therefrom. In connection with the activities of the present application salesmen, more mistakes are made on the mechanical side than on the electrical side. In applying motors it is necessary to decide whether they should be connected by belt, gear or chain to the device which they are to run, to determine the number of bearings needed, etc. The salesman must be able to analyze and draw conclusions so as to be able to present his case to the designing engineer in a clear concise manner, including details, so that the engineer will not have to go back for further information. He must also be able to present his case in a way that will be understood by the customer. He must not tell the textile man that his motor has high torque, but rather that it will throw the shuttle clear across at the first crack. In other words, he must translate electrical engineering jargon into ordinary textile mill English. He must have what the large majority of men lack, initiative. He must be able to see openings for electric motors in new fields and analyze them. For example, he must analyze a cement mill to find out whether electric motors can be installed, and how, together with all the details, and be able to determine whether the output can be increased, quality bettered and cost reduced; and must then find ways and means of getting the message to Garcia.

There are certain fundamental essentials for every salesman. He must be very enthusiastic and never discouraged. He must have confidence in himself, in his product, and in his Company. Some salesmen who think they know it all have proven weak-kneed when they strike a difficulty. The salesman must know how to present himself and his product. He must know how to get the signature at the psychological moment.

I have observed numerous college graduates and find that a great many of them are not very much good at first. The student should be awakened to an interest in his subject, and should also become interested in doing something outside of the class room which requires individual initiative. For example, he should be required to write a report on what is being done with respect to the application of motors to certain industries in the neighboring territory. The student should obtain a good foundation in fundamentals and be a good mathematician. Most students are being trained for the purpose of making a living. They should be shown how a certain formula is useful, for example, in building this or that kind of a bridge, thus awakening practical interest. They should use a slide rule. A man should go to college to get the right brain kinks, to think rightly and to reap the benefit of mixing with his fellowmen, as well as to acquire knowledge. The student should develop a keen sense of analysis and know how to express himself on his feet and to say what he thinks. He should be made to understand that, unless he can improve conditions, his work will be for nought. To improve industrial methods or conditions should be his mission in life.

To know how to think gives the right results in the long run. Of two boys, start one to college and one to work. The latter will get better pay at 22 years of age and can get results. He has mixed with laboring men but he does not know society nor how to present himself to a president or manager. At 35 the shop man has usually reached his limit; the other man passes him because he knows how to think.

College professors should study the various fields in which mechanical and electrical engineers should be located, so that they can give proper advice to their students. They should get outside men to come to the college and discuss the fields of the future. Instead of merely hearing the boys recite they should get into human relations with them. Psychologists should sotr the freshmen on coming to school. The teachers should then get at the souls of the students and attempt to build men rather than to cram brains. I have a great admiration for teachers, as there is no calling so great as that of building men.

An Important Resolution

At the recent Detroit convention of the Electrical Contractors' Association a resolution was passed to the effect that all wires larger than No. 16 should be double braided and all wires larger than No. 10 should be stranded. It was appreciated that No. 14 wire used principally in small residence wiring jobs would be affected most by the change but it was considered that the many advantages would offset the disadvantages. One very great advantage seemed to be that there will now be no necessity to manufacture both single and double braid wire so that the stock of the contractor will be reduced and he will have less capital tied up. It is said the electrical contractors at the convention were very enthusiastic in support of the motion.

The Distribution of Electric Energy

Latest Developments in Engineering practices in a. c. and d. c. General Distribution and for Street Lighting Only

A sub-committee recently appointed by the American Institute of Electrical Engineers have reported on the distribution of electrical energy. The chairman of the committee, Mr. P. Junkersfeld, describes the report as an outline of what is believed to be good engineering practice in the distribution of electrical energy for various purposes and under various conditions, which outline, it is hoped, will encourage and direct further attention to this vitally important matter.

Below we reproduce, in extract, sections of this report prepared by Mr. Philip Torchio, Mr. H. B. Gear, and Mr. P. M. Lincoln, the first on three-wire, direct-current distribution; the second, alternating current distribution, and the third, distribution for street lights only. Though these reports treat the subjects more or less in outline, much useful information is given in the way of foundation work which will be of great value to all distribution engineers

THREE-WIRE D. C. DISTRIBUTION

By Philip Torchio

The modern three-wire d.c. distributing systems consist essentially of a three-wire network of distributing mains fed by a multiplicity of cable feeders delivering current at different points of the network of mains, and a system of sub-stations supplying the current to the feeders.

With the exception of the former low-tension d.c. generating stations which have been replaced by the modern sub-stations receiving high-tension alternating current and transforming it into low-tension direct current, the complete three-wire distributing network of over 25 years ago is still giving in every respect its full 100 per cent. service alongside of all subsequent additions. This is almost a unique instance of permanency of usefulness of electrical apparatus used by central stations.

Feeders and Mains

The current was formerly distributed underground by Edison tube feeders, but in the last fifteen or twenty years the cable system has superseded the former tube systems. For feeders, concentric cables with pressure wires are often used, they being either armored and laid in the ground, as is done mostly abroad, or being drawn into subway ducts as in this country. In other cases single-conductor cables are used with pressure wires in the main cables or separate pressure wires outside. The network of mains consists of three single-conductor cables, of equal copper cross-section, drawn in distributing ducts in the streets near the curb line or sometimes under the sidewalk. This system of mains is interconnected at each street crossing, thereby making a solid meshed system. Feeders, which are laid from the station to a number of suitable points, end at a junction box into which enter the feeder cable and pressure wires, and from which issue the main cables tying to the network of mains meeting at that intersection of the street. The junction box may be installed in the manhole or just outside in the street. The neutral main cables are spliced together and grounded at frequent places; in addition, there are neutral feeder cables starting from the sub-station and going to different points on the system with frequent grounds and taps to ramifications and to the neutral mains. The total amount of copper for neutral feeders is about one-twelfth of that for positive and negative feeders.

In a large system the amount of copper for feeders and mains in per cent. of the total is as follows:

Feeders positive and negative	58.9 per cent
Feeders neutrals	4.8 per cent.
Mains positive and negative	24.2 per cent.
Mains neutrals	12.1 per cent.

Subway Ducts

Handholes are placed at convenient places along the distributing ducts and service connections are made to the adjoining buildings by tying service cables to the mains. These service cables are drawn-in an iron or fibre pipe laid in the ground and ending in the basement or cellar of the building to be supplied.

Service Connections

At the customer's service the supplying company places a disconnecting switch and protective fuses and its current registering and metering devices. A type of modern service connection for lighting and power, consists of porcelain blocks, which are equipped not only with fuses and all the connections to the watt-hour meters, but also with clips, by means of which the testing of the watt-hour meters, on the customer's premises can be readily accomplished by inserting a plug with connections to the testing apparatus, thereby avoiding interference with the supply of current to the customer while the test is being made.

All of these appliances are enclosed under covers which are locked and sealed. From this point the customer derives his supply, three-wire for lighting and two-wire for power, which services are usually metered independently.

Standard Voltages

The usual distributing voltages used in this country are, $2 \times 110 = 220$ to $2 \times 120 = 240$ volts, though in a very few instances $2 \times 220 = 440$ to $2 \times 240 = 480$ volts are used.

If the multiple tungsten lamp eventually encroaches into the field of the arc lamp, the advantages of first cost and greater radius of the higher voltage systems would assume greater prominence than heretofore.

Principal Elements in a Sub-Station

In general the full double voltage is generated by the converters or the motor-generator sets at the sub-station and the neutral of the system is secured by several means, among which are storage batteries, balancer sets, derived neutral from transformers, and other means.

The leads of the positive and negative connections are brought to separate boards. The neutral connections are made not at the board, but in the basement of the sub-station or in the cable vault. Each of the two separate positive and negative d.c. boards is equipped with multiple buses, and all the feeder switches are selected to connect to any of these several buses. By this arrangement according to the load requirements different machines can be operated on different buses at different voltages, and the shorter feeders can be connected to the low-voltage busses and the longer or more heavily loaded feeders to the higher voltage busses, thus securing voltage regulation throughout the network.

Selective switches are used for converters and feeders. By means of the edgewise system, the space occupied by the d.c. switches is reduced to a minimum, so that amounts of

power as large as 30,000 kw. at 240 volts can be distributed from one sub-station.

The references give valuable material on the modern tendencies in sub-station design and equipment which cannot be treated fully in a brief review of this kind. We may mention, however, a few features of the latest developments which made possible large improvements in economy and simplicity of station. Among them stands foremost the development of the commutating-pole synchronous converter. This, in conjunction with graphite brushes with slotted commutators and self-lubricating copper graphite brushes for the collector rings, has made the operation of synchronous converters practically independent of attendance, except for the starting up and shutting down and the periodic cleaning and setting after the machines are shut down. Other important innovations have been the split-pole synchronous converter and the synchronous booster converter for obtaining regulation.

The manufacturers have produced units as large as 4,000 kw. and they are now prepared to furnish still larger units if desired. Converters are usually six-phase and have been in many cases operated with double delta connection, though from recent tests it would appear that diametrically connected converters will operate practically under the same conditions as a double delta connected machine, and still have the advantage of greater simplicity of connections between transformers and converter. The synchronous converters are usually started from the d.c. end.

Air-blast transformers have been used most extensively and the practice of one large company is to have the blower motor connected directly to the secondaries of the transformers, so as to start it when the transformer is energized.

Storage Batteries

The installation of storage batteries at sub-stations is a distinctive feature and great progress has been made in the last few years in the adoption of the stand-by batteries, consisting of very thin plates, similar to those used for electric vehicles. These batteries can give for a short period of time large current discharges and often are designed to give, say for ten minutes, the full output of the sub-station in case of emergency.

Material improvements have been made in the method of end cell switch controls and connections.

Control

In very large systems great care is given to a number of such details, like the standard voltmeters for regulating purposes; the station lighting and power supply from duplicate sources; the telephone connections to the generating stations through independent lines and public telephone exchanges; and the emergency signals controlled from the generating station, giving simultaneous instructions by code to all the sub-stations on the system.

ALTERNATING-CURRENT DISTRIBUTION

By H. B. Gear

The distribution of alternating current will be considered to include both bulk supply and general distribution. In the larger cities where the general distribution is made from sub-stations, the bulk supply of energy is distributed by means of three-phase alternating current from the source of power to the points of distribution where it is converted to the form required for general purposes, for street lighting or for railway purposes. These lines are so numerous, and are so related to each other through tie lines, that they constitute a magnified form of distributing system with problems peculiar to themselves, which require consideration which might be lost sight of if they were classed as transmission lines.

Bulk distribution systems will be considered without regard to whether the energy is used for alternating-current distribution, direct-current distribution, or electric railway work after its conversion.

Bulk Distribution

These systems are quite universally operated on the three-phase system at 25 or 60 cycles and at 6600 to 20,000 volts. The lower voltage is used where the radius does not exceed six miles and averages much less. In some systems the longer lines have been raised to 20,000 volts or more, to handle the supply to suburban districts more flexibly. In the vicinity of Berlin there is an extensive 30,000-volt cable system serving the outlying parts of the city and suburbs. The German and English cable manufacturers have apparently been very successful in the production of cable for voltages above 20,000 volts, and such transmission lines are placed underground much more generally in Europe than in America.

The choice of frequency is fixed by the relative proportion of energy converted to direct current through synchronous converters. Where the direct-current load greatly predominates, 25 cycles is used and frequency changer sets furnish the alternating-current supply at 60 cycles. Where the alternating-current supply distribution predominates the power supply is often generated at 60 cycles. In several cases both 25 and 60-cycle generating systems are maintained; reserve capacity for each being secured through frequency changers.

Bulk supply systems have been developed in America chiefly on the principle of radial lines. A radial system is built up by the use of direct lines from power station to sub-station, one such line usually being sufficient to carry the load when the sub-station is established. The reserve source of supply, which is imperative, is usually secured by a tie line from another sub-station; or, in case of a small sub-station, by tapping another direct line at a convenient point.

The transmission system of one of the large companies in America has been developed on the principle of duplicate lines arranged with sub-stations in tandem. The converting units in each sub-station are divided into two sections so that an interruption on either line interferes with only one-half of the capacity in operation. These lines are protected by overload circuit breakers actuated by definite time-limit relays, so set that they will operate in tandem; that is, only that part of the service is interrupted which is beyond the fault in the cable.

As the loads increase and require more lines, the importance of having a diversity of routes to guard against the failure of two or more cables to the same sub-station becomes apparent. Congestion near the power station must be guarded against by limiting the size of duct runs and providing several separate conduit routes.

As sub-station loads increase, the percentage of reserve investment becomes smaller, as one reserve line is sufficient for the three sub-stations.

It is usual to provide a transfer bus at sub-stations so that any line can be connected to either tie line or to any converter.

A large proportion of the lines making up bulk supply systems in large cities is placed underground in lead-sheathed three-conductor cables drawn into ducts. The most economical use of capital is made when such cables are as large as can be properly handled. The kilowatt capacity of a high-tension cable at a given voltage increases more rapidly with increasing sizes of copper, than the cost of the cable. The most economical cost per kilowatt, therefore, requires the use of as large a cable as it is practicable to draw into a standard 3½-in. duct.

The following tables gives the maximum sizes of three-

core cable which are installed at the present time and their approximate continuous capacity at various voltages:

Volts	Size of each core	Amper	Kv. a.
6,600	350,000	290	3,200
9,000	350,000	290	4,500
13,200	250,000	220	5,000
20,000	150,000	145	5,000

The current values are taken for average conditions. They are somewhat high for situations where the facilities for heat radiation are poor, or where there is a considerable number of other cables liberating heat in the same duct line. These amounts of power could also be exceeded for a few hours during a peak load, without risk of injury.

Previous to the last two or three years it was not always satisfactory to operate high-tension lines in parallel at the sub-station end, since a fault in either of the cables supplying a sub-station is likely to open the circuit breakers of cables not affected, thus shutting off the entire supply. This was due to the absence of reliable reverse-power relays which would permit the most satisfactory parallel operation.

Prior to the development of the commutating pole converter, the largest unit which was considered advisable had a capacity of 2,000 kw. These machines were designed to carry 2,500 to 3,000 kw., however, for about two hours. It therefore became common practice to have a line for each 2,000-kw. converter or for two machines where 1,000-kw. units were installed. Thus the average load per cable was about 2,000 kw. under normal operating conditions, and as the cables used had a capacity of 3,000 to 4,500 kw., there has been an accumulation of surplus cable capacity amounting to from 50 to 80 per cent. of the maximum sub-station load. This is particularly true of sub-stations having loads above 4,000 kw. The situation is such that there is, at the present time in Greater New York and Chicago, not far from $1,000,000 worth of surplus cable investment which could have been saved if means for parallel operation of cables and larger converting units had been available prior to 1910.

The introduction of converting units of 3,000 to 4,000-kw. capacity for direct-current work and three-phase transformers of almost any desired capacity for alternating-current distribution has done much to improve this condition in recent years. These units permit the use of cables at a point near their full safe carrying capacity and make possible large savings in future cable investment.

Another source of relief has appeared in the development of protective relays designed to permit lines to be operated in parallel. The Merz-Price system has had large and successful application in the north of England in a field where its value is greatest; that of the distribution of industrial power in blocks of 200 to 1,000 kilowatts by means of a high-tension network. This system unfortunately involves the use of pilot wires which, not being included in existing cable systems, makes its introduction more expensive and difficult than a system of reverse-power relays. (An interesting modification of the Merz-Price system, in which so-called "split conductors" render unnecessary the use of pilot wires, has been developed in England; but so recently that little definite experience is available.) However, it is probably the most reliable means at present known of guarding against interruption of service by cable faults.

Modified forms of reverse-power relays have been developed within the past two years, some of which are under trial at the present time. The performance and further development of these devices will be watched with the most sympathetic interest by all who are interested in getting high-tension cable investments down to a basis of economy comparable with other reductions made in plant costs in recent years.

Alternating-Current Sub-stations

The alternating-current sub-station, in its simplest form, consists of a set of transformers with a minimum of switching equipment and auxiliaries mounted outdoors. After the load has grown so that two or more distributing feeders are necessary, circuit breakers, potential regulators and instruments must be added if first-class service is required. These require a building, the character of which is dependent upon the location and relative importance of the sub-station.

In sub-stations of 1,000 kw. or less it is usual to find oil-cooled single-phase transformers. With larger sizes, air or water-cooled units are more economical. In three-phase systems three-phase units are often employed in sizes of about 750 kw. and upward. In two-phase systems which are operated in connection with three-phase transmission lines single-phase transformers are selected for the Scott connection.

When the power supply is generated at 25 cycles the frequency-changing motor generator becomes a factor. This usually involves synchronous motors, and introduces exciters, starting compensator and necessary accessories in the way of switchboard equipment. Motors of frequency changers are usually wound for the transmission voltage to save transformer investment where the transmission voltage is not above 15,000. Induction motors are used in some cases to secure greater stability at times of system disturbance.

The induction type regulator has largely superseded the transformer type. The superior results secured from automatically controlled regulators in the regulation of pressure has made them standard for important lighting service. The details of line drop compensators, contact-making voltmeters, and motor control have undergone a steady evolution in the right direction in recent years. The adjustment of springs and condition of contacts, however, still require periodical inspection and checking of pressure at feeder ends. In Chicago it is found necessary with some 200 sets of equipment to check each of them at least once in three months by the installation of recording voltmeters for a few days at the feeder end.

The improvements in transformer design, by which weights and costs per kilowatt of capacity have been reduced, and the increasing requirements of good service, have made some striking changes in the cost of transformer sub-stations. The transformers, which one ordinarily thinks of as the chief item, constitute less than one-third of the cost of a modern 5,000-kw. sub-station, housed in a fireproof building and equipped with the required quota of oil switches, automatic regulators, duplicate busses, instrument and control panels, etc. The automatic regulators, feeder switches and distributing buses make up about half the total cost. A large part of the facilities of a modern sub-station is necessary for the safety of operating and construction men whose duties must be performed without accident to themselves or to the service and equipment.

General Distribution

The distribution of alternating current for general commercial purposes is accomplished in America almost universally by 2200-volt mains supplying step-down transformers located near groups of consumers whose premises are served by secondary mains at 110-220 volts. There are a few installations of low-tension alternating-current feeders on the Edison system at 110-220 volts in business districts, and some installations of 220-440-volt mains have been made where it was desired to avoid primary lines.

Lighting is quite generally served single phase; while power service is given from two-phase or three-phase mains.

Two-phase systems are in use chiefly where this method of distribution was established in the early period of development and is too extensive to warrant changing to the three-phase system. Three-phase systems are standard for all new installations where polyphase supply is desired for general power service.

Single-phase distribution is cheapest for lighting and small power mains at the load densities usually found outside of business districts, as the smallest size wire which should be used for mechanical strength is ample for ordinary loads. Three-phase, three-wire primary distribution is preferable in cities where sub-station loads do not exceed 1,000 to 2,000 kw., but four-wire distribution is most economical for larger loads and the greater distances which usually go with them in the large sizes. The four-wire system—being a 2300-4000-volt system—permits the supply of larger power users at outlying points more economically than by three-wire, 2300-volt systems.

The ability to regulate pressure independently on the different phases with greatly unbalanced loads makes possible the use of single-phase lighting distribution without sacrificing the advantage of three-phase transmission on the feeder.

The supply of power service in manufacturing districts is sometimes accomplished by the use of separate power feeders, the lighting being carried on other circuits. In other cases the light and power are combined. The use of separate power circuits tends to produce a duplicate distributing system and requires increased feeder capacity on account of the lower power factor, while with combined service the lighting tends to keep the power factor up. The diversity of demand between power and lighting loads also makes possible a considerable saving in feeder capacity where the lighting load in a given district is of the same order of magnitude as the power load.

Thus the policy of a combined feeder system is preferable from the standpoint of both feeder and main investment, in most cases.

With modern pressure regulating apparatus there are not many situations where the lighting service cannot be made what it should be, when power is served from the lighting system.

The primary main system cannot be interconnected as the mains in a low-tension system, because it is impracticable to provide fuse protection in such a way that it will isolate a section of main which is in trouble without simultaneously blowing other fuses through which the energy is supplied. Thus the primary system loses the advantage of parallel feeding, and requires that the feeder end be located as nearly as possible to the electrical center of the district which it serves. The arrangement which gives the best distribution of pressure thus naturally takes the form of a center of distribution with radial mains. These centers of distribution should be chosen so that the drop on the primary main will average about two per cent. from feeder end to transformer. This limit is not always commercially feasible in the case of lines to outlying districts where the load is not yet large enough to justify the cost of extending a feeder.

In cases where a feeder follows a main thoroughfare along which most of the load is located, and the side branches are short, the tree system sometimes is used. This tends to give high pressure at the near end and low pressure at the far end but saves the cost of a "back feed" main.

In three-phase, four-wire systems a modified form of the center of distribution plan may be used. The center of distribution of each phase is located with reference to the electrical center of the single-phase load carried by that phase. Since each phase can be regulated for pressure separately this gives a good distribution in scattered districts, and permits feeders to be loaded more heavily than is possible when the load is distributed from a single center. In the denser business districts it is possible to pick up enough load for a feeder within a small radius, and a single center is adequate.

The separated centers of distribution can be used in two-phase systems but do not work out well for three-wire, three-phase circuits, since the line drop compensators cannot be set to take care of drop in the single-phase branch after it leaves the other phases.

Emergency Switching Points

Where portions of the primary system are underground and where mains of adjacent feeders come together it is important that suitable facilities be provided by which the mains of the two circuits may be joined together in emergencies. Cable repairs require a considerable time and if service is to be resumed promptly such emergency connections must be provided in sufficient number to permit the minimum interruption of service. Emergency switching points are also necessary as a means of putting sections of cable out of service while new cable taps are being cut in. The safety of linemen and continuity of service largely depend upon the facility with which sections of the primary main system may be controlled. Outdoor types of oil switches are used to some extent on important branches. The disconnecting type of porcelain pothead is found well adapted to this work, particularly at cable poles.

Secondary Main Systems

The arrangement of secondary mains depends largely upon the density of the load. In outlying districts where the load runs from one to ten kilowatts in each block the size of secondary wires is comparatively small and the distances between transformers are such that the interconnection of adjacent secondary mains is not commonly desirable. The geographical arrangement of such mains tends to follow principal streets with few important mains intersecting. The failure of a transformer fuse under these conditions throws an overload on the adjacent transformers and the entire interconnected main is likely to be put out of service.

In the denser parts of a city where business buildings are served, a cross-connected network may be developed. This is less likely to cause trouble as the load of any transformer in trouble is usually divided between more than two transformers, and the danger of blowing other transformer fuses is lessened.

The secondary system may be protected against trouble originating in the transformer by the use of "network protectors." In New York City it is customary to operate the larger transformer secondaries in parallel, using such a device quite generally. The "network protector" consists of a small transformer having the same ratio as the main transformer. The primary and secondary leads of the main transformer are carried through the protector in series. In case of a defect in the transformer the fuses of the protector quickly open the connections to the network and thus prevent the current from blowing the fuses of other transformers.

The interconnection of secondary mains has the advantage of permitting the use of spare capacity, where available, to take overloads on adjacent transformers. The diversity factor between different groups of customers may thus be utilized to make a reduction of transformer investment in some cases.

Motors cannot usually be served from lighting secondaries (except in the smaller sizes) without interfering with lighting service, on account of the fluctuations of pressure caused by starting currents. Where the requirements of lighting service are high it is therefore necessary to in-

stall separate transformers for power customers having motors of five h.p. and upward. In scattered residence districts it is often necessary to put motors of one h.p. and larger on separate transformers.

In alternating-current distribution in congested business districts where a network may be developed underground with loads of 75 kw. and upward in each block, it is very desirable to be able to serve light and power from one system except, perhaps, for users requiring about 26 h.p. and upward. The problem has been met in several instances by retaining the 500-volt direct-current distribution and establishing a three-wire Edison alternating-current network for the lighting and miscellaneous small power in the congested business portion of the city.

The secondary network of mains may be supported by transformers in vaults with primary feeders or by low-tension feeders from a centrally located sub-station. The primary feeder supply is the more usual as it follows the natural course of development.

As the load density increases the difficulties of getting ventilation and adequate space for the vaults multiply. The installation of a sub-station, centrally located, with alternating-current, low-tension feeders at the proper points, finally becomes the most economical and practical plan. About enough is saved in the cost of the vaults and transformers to offset the extra cost of feeders.

Where there is no direct-current power system provision must be made for alternating-current power service. In smaller cities this is provided for by separate transformers for the elevator service and for the larger general power. This permits the lighting to be served by single-phase, three-wire secondary mains.

In cities where lines are underground in the business district it is very desirable to be able to serve all customers from one set of mains as far as possible. This may be done by the use of four-wire, three-phase, 115-200-volt secondary mains supported by transformers and primary mains, or by low-tension feeders.

The proper distribution of lighting load between phases must be maintained in order to avoid the effects of unbalance. The odd voltages of this system are a bar to its adoption if any considerable number of 220-volt motors are already in service, or if the lamps are rated lower than 110 to 112 volts.

When the load rises above 150 kw. per block, the problems of carrying large volumes of alternating current in lead-sheathed cables multiply, and a condition is reached where direct-current distribution seems to be a practical necessity from the cable standpoint, and the importance of the service requires the protection of the storage battery.

Transformer Selection

The determination of probable maximum demands of a user or group of users is of much importance in the selection of transformer sizes. Information based on experience and analysis of demands of different classes of users is necessary to avoid excessive investment in line transformers, as well as unnecessarily large core losses.

The systematic checking of transformer loads by the use of a suitable demand instrument is an important factor in keeping transformer investment within proper limits. This practice is followed by the larger central station companies quite generally. The practice of making contracts with large users on the basis of a demand measured by recording types of demand meters is of great assistance, as the maxima may be kept track of from month to month through the year and added load discovered as soon as it materially affects the demand.

The diversity factor between a group of consumers is so great in some cases that the demand of the group is very different from the demand of the individual users composing the group. The diversity factor is greater for residence consumers and similar classes whose use varies with their habits of living, than for commercial users whose requirements are fixed by more uniform conditions and whose demands individually are a larger proportion of their connected installation.

The following table represents average experience in the determination of demands of individual consumers and groups of consumers:

Table of Maximum Demand Factors

Classes of Users	Lighting Service Single	Group
Houses and Apartments	55 per cent.	20 per cent.
Offices	72 " "	60 " "
Small Stores	75 " "	60 " "
Hotels	35 " "	..
Churches	50 " "	..
Hospitals	60 " "	..
Manufacturing	70 " "	..
	Power Service	
Less than 5 h.p.	86 " "	70 " "
6 to 10 h.p.	66 " "	62 " "
11 to 20 h.p.	65 " "	63 " "
Over 20 to 50 h.p.	53 " "	45 " "

The demand is given in this table as a percentage of the connected load.

The construction of alternating-current distributing lines for general service is very largely overhead. The use of underground work is necessarily limited to districts where the load density is such as to warrant the increased expense. In general, underground construction costs from three to five times as much as overhead work, where the load density is such as to require a 2,200-volt main system.

Feeders and primary mains are sometimes placed underground on main thoroughfares, leaving the transformer secondaries and services overhead. This eliminates much of the risk incident to heavily loaded pole lines and avoids putting the more expensive part of the distribution underground.

The cost of distribution systems is materially increased by the necessity of doing the work piecemeal. The plant investment must be made with relation to the income which is likely to be derived within the period immediately following construction. The lines are therefore extended a block or two at a time, as the city grows, and the demand for service increases. The feeder system must be reinforced as may be necessary from time to time, to carry the added load. This involves re-arrangement of connections of primary mains and many complicated "cut-overs" which add to the expense very materially.

DISTRIBUTION FOR STREET LIGHTING SERVICE

By Paul M. Lincoln

The problem of distributing power for the specific service of street lighting is quite different from that of power distribution for commercial lighting and other purposes. There are two peculiarities which differentiate it particularly from the usual distribution problem. These are:

1. That the area over which the power for street lighting must be distributed, must, at the same time, be served by an entirely separate general distributing system.

2. That all of the power for street lighting service must be switched at certain predetermined periods of the day, being needed only in the hours of darkness.

The fact that street lighting is required only at night makes it desirable that this particular service shall be fed by a separate distributing system, so that the power for use thereon may be turned on and off at will from a single point.

The alternative to the separate street lighting distributing system is to use the same distributing system for street

lighting as for other purposes and to have the street lamps switched off and on singly or in groups at a point near the location of the lamps. This latter alternative presents so many difficulties that it has been used only to a very limited extent, where groups of lamps are located in a small area such as a small park or playground. Where lines are all underground, it is usually cheaper to give this service from the general network and switch it at various points by hand than to build separate circuits.

The requirements for the simultaneous lighting and extinguishing of all street lamps led to the development and continued use of the so-called "series system." In this system, all of the lamps of a given circuit are operated in series at a constant current. The amount of current used varies with the type of lamp, from a minimum of about four amperes, with some of the more recent types of lamps, to a maximum of approximately ten amperes, which was the standard when Brush brought out his first arc lamps. Ten-ampere series circuits are also the standard current rating for long-burning flame carbon arc lamps, which have recently been developed and are being extensively used in this country. Approximately 20,000 of these lamps have recently been placed in operation in Chicago. The voltage on a circuit varies, of course, with the number of lamps, reaching a maximum of 10,000 to 12,000 volts in some cases. There are at present in use, two methods of securing the constant current required by series street lighting systems:

1. The use of a constant-current generator, in which the voltage varies with the load on the circuit.

2. The use of a constant-current transformer, which receives constant-potential alternating-current energy and delivers constant-current alternating-current energy, the potential of which depends upon the load of the circuit.

The constant-current generator may be either direct-current or alternating-current, but practically all arc machines are of direct-current type. It is noticeable, also, that practically the only type of direct-current arc machine that has survived is the so-called "Brush arc machine," which is a direct descendant of the original machine designed by Charles F. Brush back in the days between 1875 and 1880.

The ease of securing constant alternating current by means of the constant-current transformer, together with the general adoption of constant-potential alternating-current systems for general power supply purposes, has made the use of a.c. constant-current arc service very general. The invention some ten years ago of the mercury arc rectifier has also enabled us to obtain constant direct-current from the constant-current transformers, using, as a source of supply, the standard constant-potential alternating-current systems that have now become standard. Therefore, the use of such constant-current transformers in conjunction with rectifiers has largely taken the place of the constant-current direct-current arc machines, and, as time goes on, the displacement of the arc machine by the rectifier will probably become more and more complete.

The advantages of constant-current operation, as compared to constant-potential for the operation of street lights, are numerous. They are so sweeping as practically to eliminate the constant-potential service for this purpose. They may be enumerated as follows:

1. The lamps may be lighted and extinguished from the central station exactly on any predetermined schedule. This is the fundamental requirement that has made necessary the development of a special distributing system for this purpose.

2. Constant-current circuits, as developed at present, have a relatively small amepere capacity (from four to ten amperes) and are available at a relatively high voltage (8,000 to 10,000). Consequently, the investment in copper for distribution purposes is reduced to a minimum.

3. The constant-current arc lamp system is inherently stable, whereas the constant-potential arc lamp must induce its stability by means of a series resistance of considerable value. The amount of this series resistance is comparatively large in constant-potential circuits, since it is necessary to operate the arc on available commercial voltages which are higher than required. Naturally, therefore, this excessive resistance decreases the efficiency of the constant-potential arc lamp.

4. When metallic filament lamps are used instead of arc lamps on constant current, we also have important advantages. The filaments of the constant-current lamps are of larger diameter and shorter than those demanded by constant-potential lamps, and, as a consequence, the lamp is not only stronger and less liable to damage but also it is subject to smaller radiation losses on account of the smaller area exposed. This latter advantage is particularly noticeable in the "nitrogen-filled" lamp which holds out so great promise of future developments.

A system of street lighting which is a compromise between the constant-potential system for individual lamps and the constant-current system is one in which a series of lamps is operated across a constant-potential circuit. In this system 2,200 or other available voltage is used to operate a series of metallic filament lamps, each series having a sufficient number of lamps to make the total voltage across the series the same as that of the line.

In order to prevent the breakage of a single lamp interrupting service on the entire series, each lamp is shunted by a special reactance coil. This coil is so designed that it takes but a small proportion of the total current of the system while the lamp is burning. If, however, the lamp filament should break, the entire current of the circuit passes through the reactance coil without danger to the coil. This characteristic is obtained by designing the iron circuit of the reactance coil so that it is operated above the bend of the saturation curve when passing the entire current of the circuit. At the same time, it is possible to obtain a curve of regulation, so that a considerable percentage of the total number of lamps on the circuit may be out of service before the current on the whole circuit is reduced beyond allowable limits. In this system we may see a return to a system which was used at least twenty years ago. The writer well recalls the use of these identical devices in the apparatus that was built in 1892.

This sytsem has the material advantage that it does not require switching service for each individual almp, but that this service may be accomplished at one point for an entire series of 30 to 35 lamps. Also, it is quite possible to group the switches for a number of circuits at one point. By this means, theerfore, the cost of switching may be reduced vastly below what would be necessary if each individual lamp required this service.

At the annual meeting of the Laurentide Company, Limited, Mr. G. Chahoon, Jr., the vice-president and manager, referred to the hydro-electric development being carried out at Grand'Mere, P.Q. He expressed the opinion that there will be a large increase in the demand for power as a result of the war. He said that more inquiries had been received along these lines in the last three weeks than in the previous three months. This was due to the fact that many American manufacturers were contemplating opening branches in Canada. For the present a part of the new construction work will be postponed. During the year $1,645,-299 were spent on the power development.

Automatic Signals on Victoria Bridge

By Mr. R. F. Morkill*

Early in July of the present year the Grand Trunk Railway System put into service their new a.c. automatic signals across the Victoria Jubilee Bridge and the approaches thereto, thereby replacing the old Hall disc signals which had been in continuous service there for the last fourteen years. The Victoria Jubilee Bridge across the St. Lawrence River, which connects the Island of Montreal with the mainland, is one of the largest bridges on the American continent—having accommodation for two steam and one electric railroad tracks and also a large roadway and footpath. The steel work is about 6,600 feet in length. This new a.c. installation included the equipping of the double track from Point St. Charles on the Montreal end to Saint Lambert on the south shore of the run—a distance of about 3½ miles. At the St. Lambert end the automatics tie into the new 64 lever G.R.S. all-electric interlocking plant. Four other railroads lease running rights from the Grand Trunk over this bridge, namely, the Central Vermont, the Delaware & Hudson, the Quebec, Montreal & Southern and the Intercolonial. On account of extremely heavy traffic the length of the blocks was made comparatively short—ranging from 2,500 to 3,600 feet.

The installation in general follows the latest recommended practice in a.c. signal work. The signals are the Union Switch & Signal Company's top post T-2 mechanism operated by a single phase 110 volt, sixty cycle a.c. induction motor. The so-called wireless control circuits are used, employing the Union Model 12 polyphase, three position relay; the local coils of these relays receive their energy at 12 volts potential from the track transformers. Track transformers also supply the energy for track circuits and electric signal lamps. All signals are electric lighted by two 2 c.p., 2½ watt, 6 volt tungsten lamps burning in multiple; Dressel convertible R.S.A. lamps equipped with Model 9 electric sockets are used.

The centre span of the bridge has a steel floor system which necessitated the use of a trap circuit; two vane type relays are used on this trap circuit.

All main line switches are equipped with Universal switch circuit controllers and Z type switch indicators operating at 110 volts. The indicators are of the normally energized type standing when clear at 45 degrees in the upper right hand quadrant.

The high and low tension line wires are supported on a single cantilever cross arm, the two high tension wires being placed on the outside and spaced 18 inches apart and the low voltage wires on the inside and spaced 12 inches apart. On the bridge this cantilever cross arm is attached to the vertical bridge members and off the bridge to the steel poles of the Montreal Light, Heat & Power Company, which run along the G. T. R. right-of-way. Due to the difficulty of double arming, a special forked bracket pin was used set on a single cross arm as shown in Fig. 1.

No. 6 B & S gauge hard drawn d.b.w.p. insulated copper wire was used for the high tension line. Dossert solderless cable taps were used to connect the leads running from the high tension line to the transformer primaries. No. 10 B & S gauge 40 per cent. copper clad wire with d.b.w.p. insulation was used for the low voltage line. MacIntyre copper line sleeves were used throughout in making all joints in line wire.

On the bridge proper all wires are enclosed in sherardized conduit with condulet fittings so that in no case are wires exposed. No wooden trunking whatever is used on the bridge structure. Reference to Fig. 1 will give a general idea of how the conduit work was installed.

On the bridge structure proper great difficulty was experienced in getting the necessary clearance for the signal blade without placing it so high as to have it obscured from the engine man's view by the steel work. The difficulty was overcome by using a style T-2 dwarf signal mechanism set on a steel cantilever platform which was rivetted to the end post of the truss. The spectacle casting was a special design with the blade attached to the bottom of the casting so as to give the maximum clearance and best view, yet arranged so that as it moved from the stop to clear positions, at no point would the clearance be decreased below that of the blade in the stop position. The platform, signal mechanism, and spectacle are clearly shown in Fig. 1. On this same platform is mounted an ordinary relay post and box in which are placed the relays, track transformer, reactances, and low voltage lightning arresters. The line transformer and high voltage lightning arresters are also mounted on the platform. Reference to Fig. 1 shows the general arrangement.

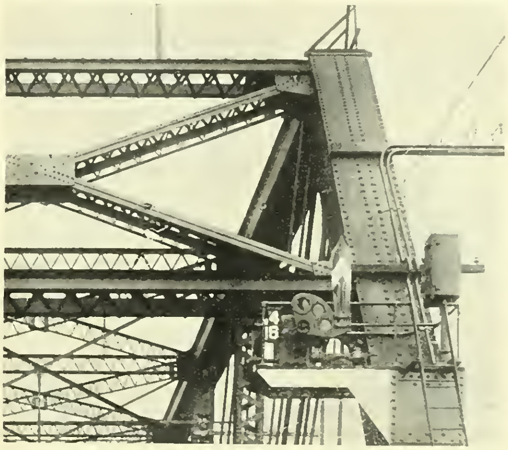


Fig. 1—Signal system on Victoria St. bridge.

Power for operating these signals is obtained over a single phase, 60 cycle, 2200 volt transmission line. Under normal conditions power is purchased from the Montreal Light, Heat & Power Company. The a.c. transmission line is sectionalized at two points so that a transmission line failure will not necessarily tie up the entire installation. General Electric Company double pole, Form P, out door type oil switches are used for this purpose. At the east end of the bridge the switch is mounted on the transmission pole line. The pole is provided with steps and painted white so as to facilitate finding it at night in case of failure. The sectionalizing switch at the west end of the bridge is mounted on a steel platform attached to a large "A" frame steel transmission line support of the Montreal Light, Heat & Power Company.

General Electric Company multigap type, Form F2, lightning arresters, enclosed in asbestos lined weather-proof wooden boxes, are used to protect the high tension transmission line. Two of these are placed at every transformer location. Off the bridge structure No. 3 Paragon ground

* Signal Engineer, Grand Trunk Ry. Co.

cones, set in coke, were used for high tension lightning arrester grounds. On the bridge structure both the high and low tension lightning arresters were grounded to the steel work of the bridge. A bare No. 6 B & S gauge, 40 per cent. copper clad, line wire was strung the entire length of the bridge and grounded at each end through a No. 3 Paragon ground cone set in coke. At each signal or transformer location the bridge structure was connected to this ground wire. Off the bridge structure the low tension lightning arresters were grounded through a coil of 12 turns of No. 6 B & S gauge bare copper wire placed one foot below the concrete foundation. Low voltage lightning arresters were used in all wire leads to either line or track.

In the St. Lambert interlocking plant there was installed an auxiliary power supply consisting of a storage battery, d.c. - a.c. motor-generator set, and step up transformer, together with the necessary switching apparatus. This auxiliary plant has sufficient capacity to operate the interlocking plant and a.c. signal system for about five hours. Due to the extremely heavy traffic over this installation a continuity of signal service was essential and therefore an auxiliary power supply was installed. The Montreal Light, Heat & Power Company bring their energy into Montreal over six independent power lines and in addition have a

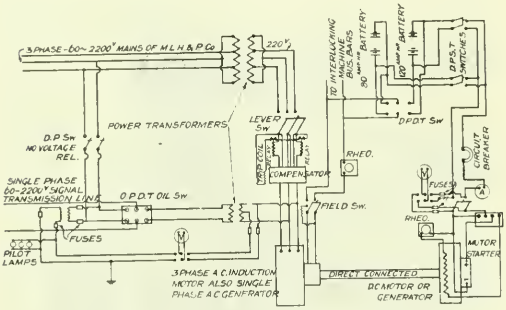


Fig. 2—Arrangement of supply apparatus.

large reserve steam plant so that a power failure lasting more than five hours should be a very rare occurrence.

The former power equipment at the St. Lambert all-electric plant was enlarged and changed to provide both the d.c. for the all-electric interlocking plant, and in cases of emergency, a.c. energy for the a.c. signal system.

Fig. 2 shows diagramatically the arrangement of this apparatus. Normally 3 phase, 60 cycle energy, at 2200 volts, is purchased from the Montreal Light, Heat & Power Company. This is stepped down to 220 volts by 3 single phase out door type transformers, mounted on a pole outside the tower. This 220 volt energy is then led to a special 3-phase a.c. induction motor which drives a d.c. generator. This generator is used to charge two storage batteries—one of 80 ampere hour and one of 120 ampere hours capacity. Switchboard equipment is such that any one of the following combinations can be arranged:—

(a) Charge both batteries at the same time.
(b) Charge either battery separately.
(c) Charge one battery and have the other supplying energy for the all-electric interlocking plant.
(d) Have one battery supplying energy for the all-electric interlocking plant and the other supplying energy to operate the d.c. - a.c. motor generator set.
(e) Have either battery supply energy to the all-electric interlocking plant.

Normally the a.c. signal transmission line is fed right off one phase of the 2200 volt, 3 phase, a.c. line entering the St. Lambert interlocking tower. Should this energy fail, a circuit breaker would automatically open. The auxiliary power set would then start up, the 200 ampere hour storage battery supplying the energy necessary to operate both the a.c. signal system and the d.c. all-electric interlocking plant. The d.c. generator is run as a motor and the special 3-phase induction motor is operated as a single phase a.c. generator supplying a.c. 60 cycle energy at about 200 volts. This is then stepped up to 2200 volts and fed out on the a.c. signal transmission line.

The d.c. - a.c. motor-generator—generator-motor set is mounted on a concrete foundation. Besides this are mounted the two switchboard panels and beyond is the storage battery room. On the wall are mounted the disconnecting switches and fuse blocks. All transformers are of the out-door type and located on poles outside the tower. All wire leads between pole line, transformers and tower are in cable enclosed in sherardized conduit.

This installation is the first of its kind in Canada. All signal apparatus was manufactured and installed by the Union Switch & Signal Company. Switchboards and power equipment were purchased from the General Electric Company, and installed by the railway company's forces.

Montreal Notes

Some weeks ago the City Council appointed Messrs. M. J. Butler and P. Gagnon a commission to prepare a report on the value of the property of the Montreal Water and Power Company. This step was taken in view of the prospect of the city purchasing the company's property. The report, which has just been handed in, places the value of this property at approximately $7,000,000.

About forty members of the Montreal Electrical Society on September 5 visited the shops of the Montreal Tramways Company at Youville, just outside the city. The shops are used for assembling and repairing cars and are exceptionally well equipped for this purpose, being so arranged as to provide for economy in handling cars and parts. The Hamburg, Germany, new car shops are modelled entirely on the Youville plan. The machinery is electrically driven, d.c. being used in all shops, with the exception of the carpenters', where 3-phase 220 volt current is employed. The members of the Society were met at the St. Denis Street office by Mr. D. E. Blair, superintendent of rolling stock, and members of his staff and taken in a special car to Youville, where Mr. Blair conducted the members over the shops, explaining the methods of working, etc.

The Montreal Light, Heat and Power Company have given $10,000 to the Canadian Patriotic Fund, while the employees of the company are each donating a day's pay. Mr. J. S. Norris, the general manager and secretary, has issued a bulletin supplementary to the one published in our last issue. This reads: "Inasmuch as reserves were not provided for, the management is now pleased to announce that English and French reservists (employees of the permanent force) enlisting for active service in the present war will retain their status as employees as regards pension fund and other benefits, with an allowance of $1.00 per day for married men and 75c per day for single men from the date of enlisting to the date of discharge or death (not exceeding six months) on presentation of enlistment and discharge papers duly certified by departmental manager, enlistment papers to be submitted before leaving and discharge papers after returning to the country. If desired accrued pay as above will be paid fortnightly to employees' dependents on order." The published lists of Montreal men volunteering for the front contain a very large number connected with various branches of the electrical industry.

Standardized Rules and Definitions

The American Institute of Electrical Engineers has adopted, subject to editorial revision, a number of definitions and rules called "standardization rules." This is the outcome of a large amount of work which has been proceeding since 1898 as the result of the appointment at that time of a Committee on Standardization, the personell of which has been changed and enlarged from time to time as requirements appeared to demand. The standardization rules include 567 topics. A large number of these are definitions which have reference to subjects of almost daily interest to electrical engineers and operating men. We are reproducing a number of these herewith and others will follow as space permits. In these standardized definitions it is to be understood that those about which there can be no misunderstanding are, for the most part, omitted.

Definitions

Note. The following definitions are intended to be practically descriptive, and not scientifically rigid.

CURRENT, E.M.F. and POWER

(The definitions of currents given below apply also, in most cases, to electromotive force, potential difference, magnetic flux, etc.).

1. **A Direct Current** is a unidirectional current. As ordinarily used, the term designates a practically non-pulsating current.
2. **A Pulsating Current** is a current which pulsates regularly in magnitude. As ordinarily employed, the term refers to unidirectional current.
3. **A Continuous Current** is a practically non-pulsating direct current.
4. **An Alternating Current** is a current which alternates regularly in direction. Unless distinctly otherwise specified, the term "alternating current" refers to a periodic current with successive half waves of the same shape and area.
5. **An Oscillating Current** is a periodic current whose frequency is determined by the constants of the circuit or circuits.
6. **Cycle.** One complete set of positive and negative values of an alternating current.
7. **Electrical Degree.** The 360th part of a cycle.
8. **Period.** The time required for the current to pass through one cycle.
9. **Frequency.** The number of cycles or periods per second. The product of 2π by the efficiency is called the angular velocity of the current.
10. **Root-Mean-Square or Effective Value.** The square root of the mean of the squares of the instantaneous values for one complete cycle. It is usually abbreviated r.m.s. Unless otherwise specified, the numerical value of an alternating current refers to its r.m.s. value. The r.m.s value of a sinusoidal wave is equal to its maximum value divided by $\sqrt{2}$. The word "virtual" is sometimes used in place of r.m.s., particularly in Great Britain.
11. **Wave-Form or Wave-Shape.** The shape of the curve obtained when the instantaneous values of an alternating current are plotted against time in rectangular co-ordinates. The distance along the time axis corresponding to one complete cycle of values is taken as 2π radians, or 360 degrees. Two alternating quantities are said to have the same wave-form when their ordinates of corresponding phase (see § **13**) bear a constant ratio to each other. The wave-shape, as thus understood, is therefore independent of the frequency of the current and of the scale to which the curve is represented.
12. **Simple Alternating or Sinusoidal Current.** One whose wave-shape is sinusoidal. Alternating-current calculations are commonly based upon the assumption of sintsoidal currents and voltages.
13. **Phase.** The distance, usually in angular measure, of the base of any ordinate of an alternating wave from any chosen point on the time axis, is called the phase of this ordinate with respect to this point. In the case of a sinusoidal alternating quantity, the phase at any instant may be represented by the corresponding position of a line or vector revolving about a point with such an angular velocity ($\omega = 2\pi f$) that its projection at each instant upon a convenient reference line is proportional to the value of the quantity at that instant.
14. **Non-Sinusoidal Quantities** are quantities that cannot be represented by vectors of constant length in a plane, and the following definitions of phase, active component, reactive component, etc., are not in general applicable. Certain "equivalent" values, as defined below, may, however, be used in many instances, for the purpose of approximate representation and calculation.
15. **Crest-Factor or Peak-Factor** is the ratio of the crest or maximum value to the r.m.s. value. The crest factor of a sine-wave is $\sqrt{2}$.
16. **Form Factor** is the ratio of the r.m.s. to the algebraic mean ordinate taken over a half-cycle beginning with the zero value. If the wave passes through zero more than twice during a single cycle, that zero shall be taken which gives the largest algebraic mean for the succeeding half-cycle. The form factor of a sine-wave is 1.11.
17. **Distortion Factor** of a wave is the ratio of the r.m.s. value of the first derivative of the wave with respect to time, to the r.m.s. value of the first derivative of the equivalent sine-wave.
18. **Equivalent Sine Wave.** A sine wave which has the same frequency and same r.m.s. value as the actual wave.

*19. **Phase Difference: Lead and Lag.** When corresponding cyclic values of two sinusoidal alternating quantites of the same frequency occur at different instants, the two quantities are said to differ in phase by the angle between their nearest corresponding values, e.g., the phase angle between their nearest ascending zeros or positive maxima. That quantity whose maximum value occurs first in time is said to lead the other, and the latter is said to lag behind the former.

*20. **Counter-Clockwise Convention.** It is recommended that in any vector diagram, the leading vector be drawn counter-clockwise, with respect to the lagging vector.

*21. **The Active or In-Phase Component** of the current in a circuit is that component which is in phase with the voltage across the circuit; similarly the active component of the voltage across a circuit is that component which is in phase with the current. The use of the term energy component for this quantity is disapproved.

*22. **The Reactive or Quadrature Component** of the current in a circuit is that component which is in quadrature with the voltage across the circuit; similarly the reactive component of the voltage across the circuit is that component which is in quadrature with the current. The use of the term wattless component for this quantity is disapproved.

*23. **Reactive Factor** is the sine of the angular phase difference between voltage and current, or the ratio of the reactive current or voltage to the total current or voltage.

*24. **Reactive Volt-Amperes.** The product of the reactive component of the voltage by the total current, or of the reactive component of the current by the total voltage.

*25. **Non-Inductive Load and Inductive Load.** A non-inductive load is a load in which the current is in phase with the voltage across the load. An inductive load is a load in which the current lags behind the voltage across the load. A condensive or anti-inductive load is one in which the current leads the voltage across the load.

26. **Power in an Alternating-Current Circuit** is the average value of the products of the coincident instantaneous values of the current and voltage for a complete cycle, as determined by a wattmeter.

27. **Volt-Amperes or Apparent Power.** The product of the r.m.s value of the voltage across a circuit by the r.m.s value of the current in the circuit. This is ordinarily expressed in kv.a.

28. **Power Factor** is the ratio of the power (cyclic average as defined in §26) to the volt-amperes. In the case of sinusoidal current and voltage, the power factor is equal to the cosine of their difference in phase.

29. **Equivalent Phase Difference.** When the current and e.m.f. in a given circuit are non-sinusoidal, it is customary, for purposes of calculation, to take as the "equivalent" phase difference the angle whose cosine is the power factor (see §28) of the circuit. There are cases, however, where this equivalent phase difference is misleading, since the presence of harmonics in the voltage wave, current wave, or in both, may reduce the power factor without producing a corresponding displacement of the two wave forms with respect to each other; e.g., the case of an a.c. arc. In such cases the components of the equivalent sine waves, the equivalent reactive factor and the equivalent reactive volt-amperes may have no physical significance.

30. **Single-Phase.** A term characterizing a circuit energized by a single alternating e.m.f. Such a circuit is usually supplied through two wires. The currents in these two wires, counted positively outwards from the source, differ in phase by 180 degrees or a half-cycle.

31. **Three-Phase.** A term characterizing the combination of three circuits energized by alternating e.m.f.'s which differ in phase by one-third of a cycle; i.e., 120 degrees.

32. **Quarter-Phase, also called Two-Phase.** A term characterizing the combination of two circuits energized by alternating e.m.f.'s which differ in phase by a quarter of a cycle; i.e., 90 degrees.

33. **Six-Phase.** A term characterizing the combination of six circuits energized by alternating e.m.f.'s which differ in phase by one-sixth of a cycle; i.e., 60 degrees.

34. **Polyphase** is the general term applied to any system of more than a single phase. This term is ordinarily applied to symmetrical systems.

35 **Per Cent Drop.** In electrical machinery, the ratio of the internal resistance drop to the terminal voltage is called the "per cent. resistance drop."

36. Similarly the ratio of the internal reactance drop to the terminal voltage is called the "per cent reactance drop."

37. Similarly the ratio of the internal impedance drop to the terminal voltage is called the "per cent impedance drop."

Unless otherwise specified, these per cent drops shall be referred to rated load and rated power factor.

38. In the case of transformers, the per cent drop will be the primary drop (reduced to secondary turns) plus the secondary drop, in per cent of secondary terminal voltage.

39. In the case of induction motors, it is advantageous to express the drops in per cent of the internally induced e.m.f.

40. **The Load Factor** of a machine, plant or system is the ratio of the average power to the maximum power during a certain period of time. The average power is taken over a certain period of time, such as a day, a month, or a year, and the maximum is taken over a short interval of the maximum load within that period.

In each case, the interval of maximum load and the period over which the average is taken should be definitely specified, such as a "half-hour monthly" load-factor. The proper interval and period are usually dependent upon local conditons and upon the purpose for which the load factor is to be used.

41. **Plant Factor** is the ratio of the average load to the rated capacity of the power plant.

42. **The Demand** of an installation or system is the load which it puts on the source of supply, as measured at the receiving terminals. The demand may be as specified, contracted for, or used. It may be expressed either in kilowatts, kilovolt-amperes, amperes or other suitable units.

43. **Maximum Demand** of an installation or system is its greatest demand, as measured not instantaneously but over a suitable and specified interval, such as a "five-minute maximum demand."

44. **Demand Factor** is the ratio of the maximum demand of any system or part of a system to the total connected load of the system, or of the part of system, under consideration.

45. **Diversity Factor** is the ratio of the sum of the maximum power demands of the subdivisions of any system or parts of a system to the maximum demand of the whole system or of the part of the system under consideration, measured at the point of supply.

46. **Connected Load.** The combined continuous rating of all the receiving apparatus on consumers' premises connected to the system or part of the system under consideration.

47. **The Saturation Factor** of a machine is the ratio of a small percentage increase in field excitation to the corresponding percentage increase in voltage thereby produced. Unless otherwise specified, the saturation factor of a machine refers to the excitation existing at normal rated speed and voltage. It is determined from measurements of saturation made on open circuit at rated speed.

48. **The Percentage of Saturation** of a machine at any excitation may be found from its saturation curve of generated voltage as ordinates, against excitation as abscissas, by drawing a tangent to the curve at the ordinate corresponding to the assigned excitation, and extending the tangent to intercept the axis of ordinates drawn through the origin. The ratio of the intercept on this axis to the ordinate at the assigned excitation, when expressed in percentage, is the percentage of saturation and is independent of the scales selected for excitation and voltage. This ratio, as a fraction, is equal to the reciprocal of the saturation-factor at the same excitation, deducted from unity, or if f be the saturation factor and p the percentage of saturation,

$$p = 100 \left\{ 1 - \frac{1}{f} \right\}$$

Deterioration of Porcelain Insulators

By J. A. Brundige *

While it has been recognized practically since the inception of the electrical art that the commoner insulating materials, such as rubber and compound treated fabrics, are subject to more or less rapid destruction when under the influence of continued electrical stress, the more solid insulating bodies, like glass and porcelain, were looked upon as being permanent in their characteristics and it was considered that they could be relied upon indefinitely to perform their functions. This idea in the minds of engineers has persistently held, even though a few pioneers a number of years ago suggested that it was not impossible that glass and porcelain might be subject to molecular fatigue when acted upon by electrical forces for long periods, similar to that exhibited by metals under repeated mechanical stresses. Now it is safe to assume that the majority of operating engineers, having to deal with higher voltage transmission lines, have had experiences which lead them to believe in the theory of electrical fatigue in porcelain. Whether this comes about solely through the continued application of the normal operating voltage or whether it is due to the transient overvoltages which are unavoidable on any line, is hard to say, but the existing evidence points to the latter conclusion.

It must not be understood that all or even the greater portion of the failures experienced with suspension type insulators are due to molecular deterioration of the porcelain. A large number of the failures have been traceable to improper design of the insulator parts or to an unsuitable porcelain body.

It has been the experience of a number of transmission companies to have practically no insulator trouble for the first couple of years of operation; then the insulators began to fail in increasingly greater numbers, for no apparent reason. Closer examination, however, sometimes revealed the fact that minute checks had formed all over the surface of the porcelain, and that the failure had been due to a crack extending clear through the shell. This behavior of the porcelain has not been confined to any kind or type of insulator nor to any one manufacturer's product.

The principal requisites for a good porcelain for high-voltage insulators, are high dielectric strength and mechanical toughness. These two qualities are somewhat opposed to each other in the actual manufacture, for when a high dielectric strength is obtained, the porcelain is apt to be brittle like glass. It is possible, however, to arrive at mixtures which exhibit both properties to a marked extent when the firing has been properly done, although it is regrettable that some so-called high-voltage porcelains appear to be lacking in both of these properties.

This can be better understood when it is learned that the mixtures used by two prominent manufacturers, each putting out a product which is accepted as reasonably good, vary greatly in the proportion of ingredients employed. While the feldspar contents of the two mixtures are of the same order, one has twice as much flint as the other, and the quantities of ball clay and china clay vary as much as three to one. Yet the different manufacturers regard their mixing formulas as trade secrets, and the proportions are religiously followed down to tenths of one per cent. This latter is doubtless done for the sake of uniformity of product, which is important, but until the mixtures more nearly approach a recognized standard, it appears that more or less trouble may be expected with high-tension insulators.

Doubtless, the factor having more to do with the failure of insulators than the porcelain body is the design; or in other words, not only must the electrical characteristics of the insulator, such as puncturing and flash-over values, both of which are highly important, be considered, but also the size and shape of the parts as well. With certain pin type insulators, especially those mounted on metal pins, cracks have been observed in quite a number of the petticoats. These were evidently expansion effects due to temperature changes. The same effects have been noticed to a greater extent with the suspension type insulators provided with metal caps and pins. We have here porcelain, cement and iron assembled together, the coefficients of temperature expansion of the three being quite dissimilar. In this latitude the temperature variation between summer and winter days is well in excess of 100 deg. fahr., and it can be appreciated that enormous internal strains must be set up inside of the caps. The porcelain being the least able to withstand these forces, is the part that suffers and cracks, with the attendant electrical punctures ensuing. In the case of an insulator designed for high mechanical strength in tension, which necessarily means a rather high cap with correspondingly long pin, the temperature changes cause a marked variation in the length of the pin, which is in contact with the porcelain through means of a layer of cement for a distance of sometimes 2½ to 3 inches along its length. The great strain to which the porcelain is subjected is then apt to produce cracks perpendicular to the axis of the pin, which has actually been found to be the case in a large number of instances. These cracks, however, are mostly very minute and can hardly be detected by the eye if the cap and the cement have been carefully removed. A line of ink drawn over the surface of the porcelain, however will nearly always disclose the cracks, as the ink will be drawn along them by capillary action.

The method of failure of suspension insulators with metal caps and pins is often quite characteristic. Cracks develop at some point inside the cap, and when the current leakage through them is sufficient, a path is fused through the porcelain by the intense heat generated. If the heating takes place relatively slowly, a hole is apt to be fused through the cap, through which gases and melted porcelain are forcibly expelled, but the insulator usually holds together and continues to support the cable. With a large amount of power back of the break, which may act in the nature of a short cir-

* Read and discussed before the A. I. E. E.

cuit inside the insulator, caps have been known actually to explode, in which event the line conductor is allowed to fall. Before the burning of the caps can take place, it is necessary that several of the units of an insulator string be bad, and instances have been observed where all the caps of ten-unit insulators have been so affected. With the better methods for locating cracks and faults as soon as they have developed, such as the high-range megger, the pyrotechnic displays above described have become fewer.

Because of several instances of trouble of this character having recently been observed in connection with suspension type insulators, some engineers have been led to believe that they are unsuccessful, which conclusion is wholly unwarranted.

The high-range megger has proved to be an extremely useful instrument for the locating of insulator faults undiscoverable so far as ordinary means of inspection are concerned. Tests made on a large number of units later checked up by tests with a high-tension transformer, have shown that the megger can be absolutely depended upon if reasonable care is used to see that there is no leakage in the conducting leads. To show the sensitiveness of the megger, the two electrodes can be placed within ¼ in. of each other on a glazed porcelain surface or upon a fractured surface where there is no glaze and the reading will be practically infinity. By blowing the breath upon this surface even when the porcelain is at a moderately high temperature, the moisture so deposited will be sufficient to give a comparatively low reading on the needle. When a crack occurs in the porcelain up inside the cap there is always sufficient moisture present in the cement to give an indication on the needle, which need not be confounded with surface leakage, if the insulator is at all reasonably clean. If the insulators are so dirty that surface leakage is marked, they should be cleaned before the megger test. Certain insulators may give a reading of from 40 to 100 megohms, and if later tested with a high-tension transformer they will not fail immediately upon the application of voltage, but may hold up until 30,000, 50,000 or even 60,000 volts is reached before puncturing. Those which show a zero reading on the megger will stand no voltage from the testing transformer.

An interesting experiment was recently made by immersing a batch of insulators in water at ordinary temperature and slowly bringing them up to the boiling point. Twenty insulators, some two or three years old, were tested in this manner and every one was found to be ruined by the time boiling point was reached. These were from two different manufacturers, one of whom has previously delivered batches of insulators where bringing them to the boiling point of water was one of the routine requirements before the insulators left the factory. Other similar tests made on new insulators of the same design did not produce failure, except in a few units. The probable explanation of this is that in the new insulators the cement had not yet attained its ultimate hardness, and allowed the expansion to take place in the pin without cracking the porcelain.

The data at hand upon insulator failures are unfortunately very incomplete, and until these are collected and have been studied, all designs brought forward must necessarily be lacking in some respect. Enough is already known, however, to indicate the general direction which the new designs will follow, and it may be confidently predicted that the troubles experienced will be materially lessened in the immediate future.

Discussion

Charles E. Waddell: Reference was made in Mr. Brundige's paper to the fatigue of porcelain. I want to suggest that this fatigue, perhaps, is not due alone to the electrical stresses, but to a combination of electrical and mechanical stresses. The majority of insulators strung up and sustaining only their own weight successfully withstand laboratory test for flash-over and puncture. The same strings of insulators when placed on the line and supporting the weight of the conductor, which may be 1,000 lb. (453 kg.) or more, break down under a very slight rise in voltage. The only conclusion I have been able to reach in the matter is, that, due to some obscure phenomenon, the dielectric strength of the insulators is weakened, and that if the mechanical stresses were removed the insulation would in all probability be as high as when actually tested.

Percy H. Thomas: The most important topic brought up it seems to me, is the matter of the so-called deterioration of porcelain. It has developed to a critical point during the last year in many different parts of the country and with many different kinds and makes of insulators. It has developed, sometimes, where it could not possibly be due to electrical causes; and sometimes it is an open question whether it is not due to electrical causes. The problem is to find out as quickly as possible what it is, and how to overcome it.

I think we can conclude that it is not due to the deterioration of porcelain per se, for, taking the worst cases of breakdown of insulators, there are many insulators which are, apparently, absolutely uninjured, or, in any which are injured, the material is good. It is, in my opinion, therefore not a deterioration of the porcelain per se. It is not always due to the presence of electrical potential. I think that in all probability a great deal of it is due to the processes of manufacture. When you consider that the material at one time is in a plastic state, and that when it is burned it has to shrink into a semi-crystalline mass, keeping every portion intact, you can see that, during the forming, the pressing and the twisting it gets, somewhere on the interior there is a slight plane of separation formed. The edges may be daubed over and adhere, yet this fault will never be corrected. There may be enough good porcelain to hold the potential during the test, while the insulator is new, before the faults develop. I think the evidence of the general situation points to this conclusion.

You cannot blame the manufacturers for it, exactly, as they are doing the best they can, and there is no one manufacturer who has all the trouble; they all say they are having trouble, and it is a problem which we must work out with time, and we must find some way of detecting the bad insulators. This can partly be done by tests, but we need a few new tests.

If we can assume that the difficulties in high-tension insulators are, most of them, due to defects depending upon the history of the individual insulator, that puts a premium on the two-piece insulator immediately. You have two shells independently made, and put them together. If one shell is defective you will not, in all probability, have another defective shell along with that. But if you use the two-piece insulator, you must have its flash-over voltage so low that a single piece of porcelain will be sufficient to withstand the full strain and prevent a puncture. If you are relying on one shell when the other is injured, you must be sure to have that shell built to take care of the flash-over by itself alone. This double-piece insulator has a great advantage mechanically, in that, if due to expansion, or heavy stress, there is a little check on the inner petticoat, due to mechanical reasons, that still leaves the outer shell intact. The mechanical strains on the outer shell are far less, on account of the larger hole in which the cement is placed. We will say that this two-piece insulator, which I have in mind, flashes over at about 90,000 volts, and has a puncture stress, depending on how quickly the voltage is brought up, between 190,000 and 200,000 volts—that is, more than 2 to 1—if you do not keep the voltage on more than two or three

seconds in bringing it up. This is, I believe, an exceedingly important matter. A number of these insulators have been given a high-frequency test, 250,000 and 300,000 volts, considerable capacity, with long series gaps, and they have shown up very well.

Farley Osgood: I think the manufacturers of our various lines of materials are doing about all that can be expected of them in the way of investigation for improvement. I do not think that the operating engineers, as a whole, are doing their share of investigating work. I think that it is up to the operating engineers to plan to spend sufficient money for proper testing schemes and devices, in order to help the manufacturers and designing engineers in the field, so that they can test in actual practice.

A point which has brought this matter vividly to my mind within the year has been our own considerable expenditure toward the investigation of the effect of high frequencies on the insulators and lines, and we found that insulators which had behaved reasonably well, as we thought, broke down very quickly under our high-frequency test.

Mr. Faccioli brought out clearly that the difficulties from voltage can be reasonably well cared for, and the difficulties from short circuits can be reasonably well cared for, particularly by means of reactance, but I do not agree with him at all that we should keep away from frequent switching. It cannot be done, in a complicated, busy territory. In our large power stations, with a heavy service, we will switch for one cause and another, twenty to sixty times a day. It cannot be stopped. It has to be done. The engineers have to meet these conditions. I entirely agree with Mr. Lincoln that if the apparatus will not meet the service requirements it must be made to.

In my opinion, the difficulties from high frequencies are not well enough understood. The reason they have not been given careful study previously is because we have been so busy eliminating the difficulties from short circuits, high pressures, etc. Having cared for these, we can now take up the study of the effects of high frequencies. If we had done this before, many of our present difficulties would not have been known to us.

J. A. Sandford, Jr.: Mr. Brundige has suggested that engineers put into every insulator specification a description of the materials to be used. I do not believe that is a possibility. I had occasion to look up not long ago the chemical analysis as laid down for what we call ball clay, or kaolin, from Kentucky, North Carolina, Georgia, one or two places in England, and one in France. You could lay these in a row here on this table and label them, and then take the labels off, and change them around, and you would never know which applied to which, they are so nearly the same. The great difference between the various clays used seems to be in their plasticity, but no one can tell what plasticity is or what causes it. Therefore, I think Mr. Brundige's suggestion would prove impracticable, particularly at the present time, with our limited knowledge of such things.

Second, on the question of fatigue of porcelain. I think that if a piece of porcelain is absolutely vitrified there is absolutely no fatigue. To my mind, what has been called fatigue of porcelain is simply the gradual giving way of porcelain that, in the first place, was not perfect, either through flaws, or from the vitrification standpoint.

To refer to a different matter, I think that a large percentage of the insulator failures on transmission lines would have been eliminated if, every time the patrolman went out to change an insulator—this has reference particularly to suspension type insulator lines—he had taken down the complete string of insulators and substituted a complete string of new insulators which he was sure were good. If you go out and look at a string of insulators on which you know there is trouble, there may be two or three disks that you can see are no good, and there may be two or three that look as if they are all right, and they may or may not be so.

William L. Puffer: I am very much interested in what has been said concerning the life, deterioration of and failure of the several types of insulators in common use, because of an investigation of mine into the cause of undue leakage over the busbar cell-work and insulations of a moderately high tension station.

In this station it was known that there was some kind of ground or similar trouble, because at times tiny sparks had been noted at the heads of bolts and washers used in assembling the insulating slabs, and several disagreeable shocks had been received by attendants. As soon as possible a section was cut out of service and the parts dismantled, and to my surprise there was found a large collection of wet green paste on the copper bolts and studs. Chemical examination proved the presence of nitric acid, water, nitrate of copper and several sub-nitrates. The surface of the porcelains and all pores and cracks were wet with nitric acid of sufficient strength to destroy organic washers that had been used to distribute the pressure between the porcelain and the clamping nuts and bolts.

Further examination proved the presence of nitric acid in the cracks of both wet and dry process porcelain bushing, on the surface of the insulating coverings of the busbar cables and on the porcelain bushings used to support the cables where they passed through walls and barrier.

I was able to prove that all of the trouble originated in the small air spaces where the potential gradient was high enough to produce light and minute sparks of the type called "static." First there was produced ozone, then nitric acid and then action on the copper with the formation of nitrates. Similar action was found about some iron washers and bolts used in the construction of switches and the switchboard.

These results were not a matter of conjecture but of actual chemical proof obtained while the parts were alive and carrying current, and it certainly suggests that if a 6,600-13,200 volt system can be subject to as great action as I found, there is ample room for thought as to what must be the conditions around the insulating parts of the highest tension lines now in use.

Whenever and wherever an insulating support shows a glow with little sparks in it there is likely to be the formation of ozone, and if a little moisture is present there will next be nitric acid. The wind may blow it all away, or a porous porcelain may slowly absorb it, with gradually lessening resistance, leading finally to a puncture and a short-circuit.

Julian C. Smith: I think operating men who have had experience in operating transmission lines of 50,000 volts and upwards, with pin type insulators, realize there has been a decided deterioration in the pin type insulators. The fact that it is easier to find the deterioration in the suspension type insulator, easier to replace the defective parts, would by no means indicate that the suspension type, per se, is any worse than the pin type. This is the more evident when you consider that practically all suspension type insulators are operating with one end grounded, whereas a relatively small number of pin type insulators subjected to the same voltage, are operating under these conditions.

E. M. Hewlett: In reference to the fatigue of porcelain, I have not seen the proof that well vitrified porcelain undergoes fatigue, unless overstrained. From anything we have seen so far, I believe that what is known as fatiguing is largely the result of flaw of some description or of incomplete vitrification. That is, when not properly vitrified, the insulators will eventually absorb moisture. The glaze will protect the insulator for a time, but gradually deteriorates and then absorption through the porcelain begins and the unbaked porcelain gradually absorbs moisture and breaks down.

Electric Railways

A Double-Deck Car Barn

Work is already well advanced on the construction of a car barn for the B. C. Electric Railway Company, Limited, at Vancouver, B.C., the estimated cost of the structure being $350,000.

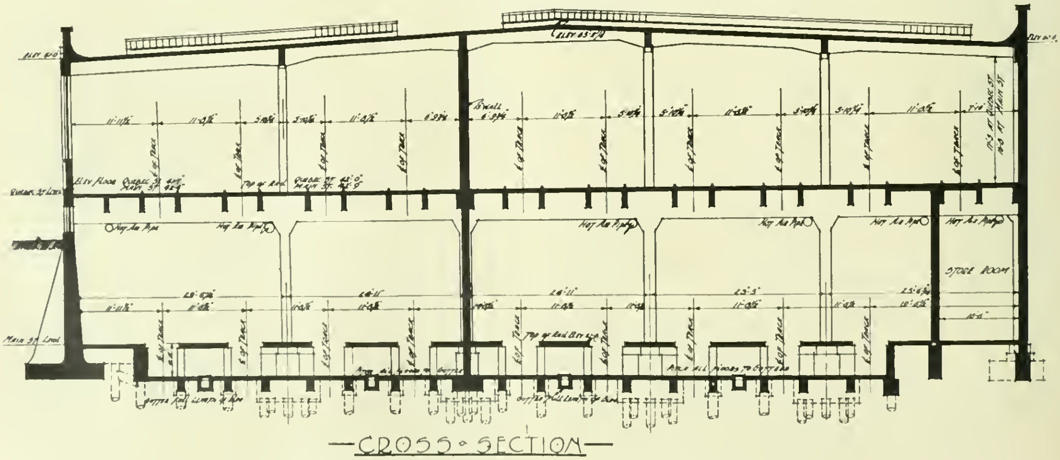
Some years ago the company purchased an entire city block in the Mount Pleasant district with the idea of utilizing the block for car barn purposes. The block has a frontage on Main Street, one of the principal car line streets in the district, and extends to Quebec Street, the other boundary streets being Thirteenth Avenue and Fourteenth Avenue. On the north half of the block the company several years ago erected two car barns of the galvanized iron type of construction, capable of accommodating 60 cars. The new barn now in course of construction is located on the south end of this block and adjoins the old structure. The new barn will be two storeys in height on Main Street and one-storey in height on Quebec Street, the difference in grade between the two streets being such as makes this plan possible. The dimensions are about 350 feet by 130 feet, the height of each storey being approximately 20 feet. On the ground floor the entire area will be available for the housing of cars, the ten trucks making provision for 62 cars. The Quebec Street frontage of the second storey is placed 45 feet back from the street line, thus giving a floor area of 302 by 130 feet, sufficient for the accommodation of 58 cars. This will make the total capacity of the new barn 120 cars and the total capacity of the company's barns on the block, 180 cars.

The block is naturally low lying and after investigation of the soil the engineers decided that a pile foundation was advisable for the new barn. The average length of the piles driven is 20 feet and the building is so designed that the entire load is carried on the piles, no allowance being made for any load being carried on the soil.

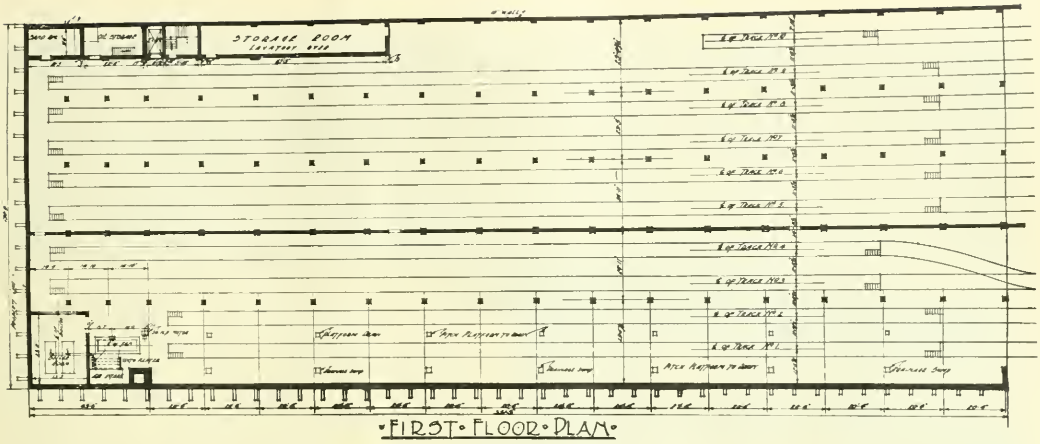
The general type of construction throughout the entire building is reinforced concrete skeleton with the exception of the columns between the first and second floors, where steel is used in order to economize floor space.

The building will be finished with 13-inch brick walls on the outside. In these walls will be fixed steel sash glazed with quarter-inch wired glass and steel doors of the rolling type which are to be chain operated. Practically all the tracks on the first floor will be provided with pits for inspection purposes. The floor consists of five-inch reinforced concrete slabs between the rails, these being supported on 12-inch square concrete piers, placed at about seven feet cen-

Interior new B.C.E.R. car barn.



Cross section B.C.E.R. Company's new car barn, Vancouver, B.C.



First floor plan B. C. E. R. Company's new car barn, Vancouver, B.C.

tres, extending from the pit floor. The pit floor is 4½ feet below the level of the barn floor and is formed of six-inch concrete with piles under each of the track pedestals and building columns. The floor is graded to drain into four channels 10 inches wide which run the whole length of the building and are covered with iron gratings.

The second floor will be used merely for storage purposes, no provision being made for inspection pits, etc. Five-inch reinforced concrete slab construction is used with reinforced concrete girders 8 by 24 ins. placed under the rails. The second storey is supported on concrete covered steel columns placed between each pair of tracks, the centres varying from 23 feet 5 inches to 29 feet 6¼ inches and the lengthwise spacing being about 20 feet 4 inches. The cross girders between the columns are 3 feet 10 inches in depth. The roof of the building will be 3½-inch reinforced concrete slab carried on cross concrete beams 18 inches in depth.

For the construction of the building it was necessary to excavate about 12,000 cubic feet of earth. The approximate amount of concrete used is 5,500 yards and the construction plans call for the use of about 400 tons of steel.

The building will be heated by an indirect heating system, oil fuel being used. This installation consists of two 70 h.p. boilers, the heating being driven through ducts running through the building, by a 130-inch fan. For the rooms set apart for the use of barn employees and street car men a direct steam heating system will be employed.

In accordance with the requirements of the fire underwriters a steel tower carrying a water tank with a capacity of 35,000 gallons will be installed above the second storey. This is connected with a sprinkler system which provides 2,450 heads throughout the building, both roof and aisle sprinklers being installed. Both floors are divided into two sections by a thirteen-inch brick fire wall.

One track on each floor will be arranged for the washing and painting of cars. On the lower floor provision is made for a room for sand drying and the storage of oil. On this floor is also located a shop for carrying out minor repair jobs, a freight elevator 5 by 8 feet in size connecting the shop with the second floor.

The cars will enter the first floor of the barn direct from Main Street. For the purpose of affording entrance to the second floor the company will construct a track from Main Street along Thirteenth Avenue and Quebec Street to the second storey entrance. The plans of the company provide for the continuation of the facade of the new barn along the entire Quebec Street frontage of the block.

It is expected that a portion of the accommodation afforded by the barns will be available by October 1st.

The new barn is designed to accommodate the cars of the company operating in the eastern section of Vancouver as well as its South Vancouver lines. For the accommodation of its cars operating in the western section of the city the company last year constructed a large car barn in the Kitsilano district.

Stepless Storage Battery Bus

The accompanying illustration represents a type of bus manufactuerd by the Field Omnibus Company, New York, in co-operation with the New York Motor Bus Company. Though the bus is double-deck type it is of such low height that it will operate with safety under trolley wires and viaducts or other elevated structures. The seating capacity is thirty-eight passengers, eighteen below and twenty above.

Double deck storage battery bus.

Height, 20 ft. 10 ins. overall; distance from ground into car 12½ ins.; height of car roof from ground 7 ft. 8 ins. The construction is of steel. The rear wheels are mounted on an auxiliary truck which carries the driving machinery. Two 10 h.p. motors operated by an Edison storage battery equipment of 100 cells supply the motor power. The lighting of the bus is from a separate set of batteries. The motive batteries have sufficient capacity for a ten-mile speed on a 6 per cent. grade.

The Car for Suburban Service

The growing importance of the omnibus as a means of transportation in city and suburban service is strongly evidenced by the increased demand for vehicles of this character. The bus illustrated herewith represents a type operated by the Interborough Bus Company, River Edge, N.J., and is mounted on a three-ton Hurlburt chassis having a wheel base of 13 ft. 6 in.

As the illustration shows, entrance and exit is made only

Bus for suburban service—seating capacity 22.

by the rear platform. The driver is enclosed in a cab on the forward left hand side of the body and has nothing to do with the collection of fares, which is looked after by the conductor. The roof of this car is of the plain arch type with double window sashes, the upper raising and the lower dropping into pockets; the sash on each side directly over the rear wheels raise. The platform at the rear is provided with a curtain which, when necessary, is drawn down to the dasher rail. A single sliding door is located in the rear bulk head. The interior is handsomely finished in ash with maple veneer ceiling. The seats are of Brill twill-woven rattan, those placed transversely having stationary backs. The driver's cab is entered through a door on the left hand side and is equipped with a comfortable leather seat. Push buttons are provided on the side posts. Yellow pine and oak are used in the under frame construction; poplar and ash in the upper frame.

The seating capacity is 22. Dimensions:—Height from ground to side sill, 3 ft. 5½ in.; side sill over roof boards, 6 ft. 11 9/16 in.; floor to headlining, 6 ft. 8⅛ in.; roadway to first step, 16 5/16 in.; first step to second step, 13½ in.; second step to floor, 12½ in. Weight of body, 3,800 lbs.

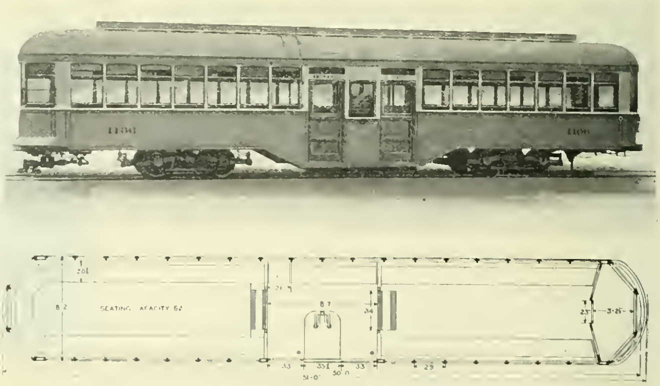
Centre Entrance Type Cars

A few months ago the G. C. Kuhlman Car Company built fifty centre entrance cars for the Cleveland Railway Company which were a considerable departure from the usual centre entrance type. These cars found such immediate favor with the public that a supplementary order for fifty more cars was placed and has recently been completed by the same car builders. Except in a few details the new cars are duplicates of those built on the former order, and like them, were designed by Mr. Terrance Scullin, master mechanic of the railway company.

The principal difference between the new and old cars is in the seating arrangement. The cars built on the first order have longitudinal seats on the devilstrip side and transverse seats on the open side, whereas the new cars are fitted with longitudinal seats on both sides. This arrangement results in slightly increased seating capacity and additional aisle space. A figure showing the entrance side of the new car is reproduced herewith as also a general plan of the car. The dimensions are: track to side sill, 2 ft. 1½ in.; side sill over trolley board, 9 ft. 6 1/16 in.; floor to head lining, 8 ft.; track to well, 12⅝ in.; well to step, 12 in.; step to floor, 7⅜; weight of car body, including electrical equipment, 22,600 lbs.

Steel shapes and plates are employed in the bottom frame construction, the sides being of the girder type. On the devilstrip side the girder is continuous and on the open side is carried over the door way by means of angle and plate posts, which are joined at the top by 3-in. I beams, angles and plates. The frame is depressed at the centre, avoiding the necessity of a step from the street to the floor of the centre well. At each end of the well are two steps leading to the floor of the car body proper. The plain arch roof is supported on steel carlines and the cars are fitted with the Scullin systems of lighting and ventilation, which are standard for the plain arch roof cars used by this railway company.

Cherry is used for the interior finish and the seats are upholstered with twill-woven rattan. As the diagram indicates, the cars are intended for single-end operation, and the rear end is provided with a curved bench. The cars are operated on the railway company's pay-enter and pay-leave system of fare collection, which has given great satisfaction in Cleveland.



Side view and plan of new Cleveland centre entrance cars.

It is reported in this section that work on the transmission line from London west through Delaware to Strathroy will be undertaken in the near future by the Hydro-electric Commission of Ontario.

Illumination

Indirect Lighting of Stores

The illustration herewith reproduces the showrooms of the Toronto Hydro-Electric System illuminated by Alexalite units. In this fixture, the electric bulb is concealed in a powerful glass enamelled steel reflector. This reflecting shield is basin-shaped and its inside formed with a plurality of concentric corrugations, producing annular reflectors with surfaces on different planes. By this means the light is reflected from one side to the other of the reflector, and it issues at the top in a greatly diffused condition, striking the ceiling and making an area of illumination larger than the diameter of the reflector, the rays of light falling nearly vertically to the working plane. The reflector has the enamel hard fired on, interior surface glazed, and the exterior dull mat finish to conform as nearly as possible in color to the ordinary plaster ceiling. Mechanical injury to the fitting is practically impossible. It is easily cleaned by the unhooking of one chain, allowing the reflector to hang by the remaining two; dust with an ordinary dust-cloth, and replace chain in position.

These fixtures are manufactured to have the upper edge of the reflector hang 18 ins. from the ceiling, and do not require any adjustment when installing. The amount of light obtained depends upon the size of lamp used. This unit is claimed to be specially adapted for use with the new nitrogen filled lamp, the lamp hanging perfectly free from any obstruction to the surrounding atmosphere. This new system, although only perfected recently, has already acquired

The illumination of a large display room with indirect units

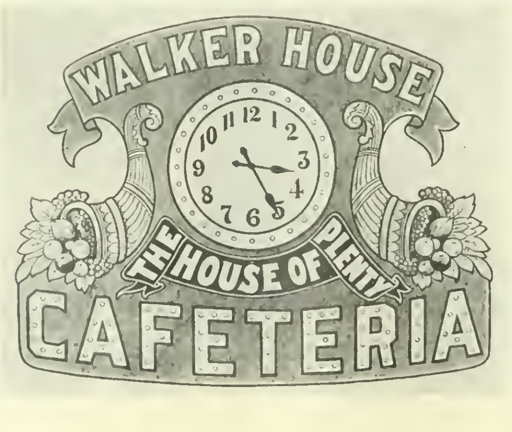
great popularity with the heads of commercial institutions, who find that, by using it in banks, counting-rooms and similar places, where a large number of employees are necessary and much clerical work must be performed under artificial light, they effect an appreciable saving of the employees' nervous energies, which may be better applied to the employer's advantage. Hospital physicians often recommend this means of illumination also for much the same reason, that it reduces the amount of nervous strain to which patients are subjected. From an eye specialist's standpoint the ideal lighting is that which illuminates the object seen, with an even intensity of light at all points. That is the reason for the feeling of restfulness claimed to be experienced when reading under the Alexalite—simply because there is no struggle going on within the eye to shut out the glare. The light is even, and the muscles of the eye are as much at rest as when working under daylight. The best daylight, undoubtedly, is on a bright day when the sun is obscured by a cloud. This is natural, indirect daylight, serviceable for all purposes excepting where a great intensity of light is required. This is the principle on which it is claimed the patent Alexalite was devised after lengthy experiments. Ideal lighting means just this—seeing without strain, distinguishing in true relation, and preserving the eyesight not only from fatigue but also from permanent injury. This can only be accomplished in one way—by removing all spots of light from the normal range of vision, and in such a way that the eye is effectually screened from the actual source of light. But further still, it means doing this in a practical way that will meet all general conditions; so it can be used commercially, possessing, in addition to the above requirements, the undoubted advantage of high efficiency, low maintenance and absolute uniformity.

The approximate height of the ceiling in this instance is 17 ft. Each fixture contains one 500 watt nitrogen filled lamp installed every 20 ft. The centre outlets previously used with other lighting fixtures is found not to be necessary in this case, as more light and much better light is obtained in the present system. This unit is adaptable for any height of ceiling up to 40 ft. The approximate candle power on the working plane in this installation is 10 or 12-foot candles. The illustration shows that ample and very even illumination is provided for all the articles on display.

This installation was designed and put in place by the James Devonshire, Limited, Canadian agents for the Alexalite Company.

A Handsome and Attracting Sign

A handsome sign has just been erected for the Walker House, Toronto, facing on Front Street, which is one of the



most attractive in the city. This is of an original design planned and built by the Denis Advertising Signs, Limited. The sign is double faced, the colors on each side being illuminated from within. The centre of the sign is occupied by a large secondary clock, operated electrically from a master clock located elsewhere in the building; this clock has a three-foot illuminated dial, and is surrounded with a circle of lights as shown. The outside dimensions of the sign are. length, 10 ft. 6 ins.; height, 8 ft. 4 ins.; 250 lights are used. The word "Cafeteria" at the bottom of the sign is composed of 16-in. letters illuminated with individual lamps and outlined with a patent gold flange to make them stand out more prominently. The colors of the sign are a green background surmounted by a proportionate admixture of blue, red and yellow.

Storage Battery Factory for St. Johns, P. Q.

Coincident with the "made in Canada" policy which is now finding so much public favour, it is satisfactory to record the establishment in this country of a new branch of the electrical industry. The Canadian Hart Accumulator Company, Limited, has been formed to develop here a business which is now carried on in Great Britain, where the parent concern manufacture batteries which are sent to all parts of the world. With British capital, the company are constructing at St. Johns, P.Q., a large storage battery factory. The building is of brick and steel, and will be ready in about six weeks. The company will manufacture a complete range of sulphuric acid batteries and all types of plates on the same principles as the batteries made in Great Britain. The list includes the Plante type, the Hart demi-plante, and the various pasted types. It is proposed to make batteries for electrical vehicles, isolated plants such as used in country houses, for central station and tramway loads, train lighting, and starting and lighting for automobiles, launches, and motor boats. Mr. C. W. Knighton is the Canadian manager.

Personal

Mr. Edward A. Hanson, city electrical engineer, Saskatoon, Sask., has been elected to membership in the Institution of Municipal Engineers, Great Britain.

Mr. Truman P. Gaylord has been elected acting vice-president of the Westinghouse Electric & Manufacturing Company, succeeding Mr. H. D. Shute. Mr. Gaylord was formerly district manager of the company at Chicago.

Mr. Henry D. Shute has been elected treasurer of the Westinghouse Electric and Manufacturing Company succeeding Mr. T. W. Siemon recently resigned to accept the position of secretary-treasurer of the Union Switch & Signal Company.

With the closing of the tie-line switch at San Bernardino, Cal., on August 13, energy was transmitted from Bishop Creek to El Centro, Cal., a distance of 400 miles, completing what is probably the longest transmission circuit in the world.

In view of the fact that the European war has eliminated several sources of permanent magnets required in the electrical industry, the announcement made by the Esterline Company of Indianapolis, Ind., is important. This company announce that they are prepared to furnish on short notice permanent magnets of the highest quality of workmanship and electrical characteristics. They have a very complete magnet manufacturing department, which has been used for the manufacture of permanent magnets for electric lighting generators for automobiles, for tachometer generators and permanent magnets for graphic instruments.

The Dealer and Contractor

Flush and Baseboard Receptacles

The increasing demand for the flush receptacle, in both office buildings and private residences, has suggested the usefulness to electrical contractors and others less closely in touch with recent developments, of a short article outlining the various types at present on the market. No attempt at comparison is made, as the value of each type of receptacle depends on a number of elements, not the least of which is the particular requirement of the individual installation, as well as individual taste. The dependable and lasting qualities of the various types, as well as their factors of safety in operation, can be best determined by experience. It seems almost unnecessary to outline even briefly the usefulness of the baseboard receptacle. In the office—for the fan, small heater, table or portable lamp; in the home—for the fan, heater, bed warmer, curling tongs, flat iron, small vacuum cleaner, water heater, toaster, and all the other household appliances, rendered all the more attractive by the low rates now being given by many companies and municipalities. It is safe to say that no other small device is capable of adding so much to the convenience and comfort of every-day life, as is the flush receptacle, and when this comes to be appreciated by the general public, their use will become many times more general. Indeed, it is not too much to expect that in the very near future, no home or public building will be considered complete without them.

In this connection too, it is well to consider the effect the installation of flush receptacles will have on increasing the use of electrical appliances. They will have the effect of creating a demand for electric current, and so should be encouraged by the central station quite as much as by the electrical contractor. The time is fast approaching when electrical appliances, which now seem luxuries, will have become necessities, when gas will have given place to the electric

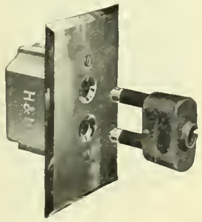


Fig. 1

Fig. 2

range, and when the electric heater will have become the recognized early fall and late spring supply of warmth.

This opens up another question—that of the size of the leading wires. The householder will be well advised in making ample allowance for future development in this direction. All these things must be explained by the electrical contractor and, if necessary, insisted upon. If the houses building to-day are not wired with sufficient capacity to take care of, at least, supplementary heating, the electrical contractor will fail in his duty, if he leaves any stone unturned to remedy this omission. The chief obstacle in the way, of course, is the untutored householder, who is unable to appreciate the advantages he has not yet experienced. The campaign of education is making good progress, however, and, without question, a big field is looming up for the electrical contractor.

The following brief references to the various figures will explain in part the characteristic features of the receptacles produced by the different manufacturers.

Fig. 1 represents the Hart & Hegeman type of flush receptacle. In this unit there are no doors to pry open, no guiding pin, no screw thread. The plug fingers fit neatly into the apertures of the face plate, and, when withdrawn, leave a very neat appearing surface.

Fig. 2 represents Machen & Mayer's screw plug type. When the plug is withdrawn, the door fits neatly over the opening, rendering it practically dustproof.

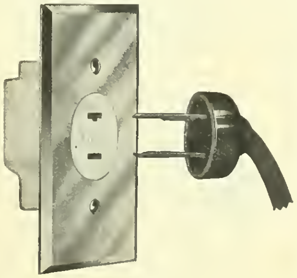


Fig. 3

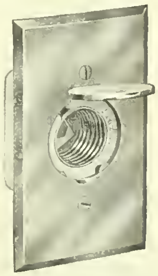


Fig. 4

Fig. 3 is another type of Machen & Mayer's plug of the simple push construction. The porcelain face plate adds to the insulating properties of the plug.

Fig. 4 is one of the Bryant types of receptacle. The advantage of this kind of receptacle is that a plug may be transferred from an electrolier or bracket and screwed into the base receptacle. When the plug is withdrawn, the door closes to keep the dust and moisture out.

Fig. 5

Fig. 6

Fig. 7

Fig. 5 shows the Machen & Mayer plug type with plug inserted.

Fig. 6 represents what is known as the Bryant "Junior" flush receptacle.

Fig. 7 is the Bryant disappearing door receptacle. The doors open and close automatically with the insertion and withdrawal of the plug. This makes this receptacle suitable for floor as well as baseboard use, as dirt and dust cannot enter it. It is also a very safe receptacle, as, when the plug is withdrawn, the doors are shut tight by stiff springs, so that it is almost impossible to gain access to the live parts.

Fig. 8

Fig. 9

Fig. 8 represents the Chapman type of plug manufactured by the Chelten Electric Company, Philadelphia, Pa. The doors fit neatly over the plug, giving a smooth and very neat appearance.

Fig. 9 is the Edison screw type also manufactured by the Chelten Electric Company. This will take any standard screw plug. The plates are dustproof, well finished, and neatly hinged and fitted.

Fig. 10

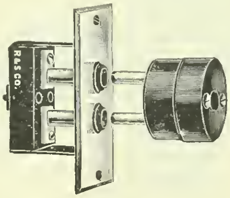


Fig. 11

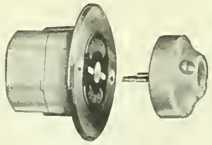


Fig. 12

Fig. 10 represents what is known as the Chelten Composite Type receptacle.

Fig. 11 is a very neat receptacle, manufactured by the Russell & Stoll Company, New York. This fitting is particularly adapted for vacuum cleaners and heating appliances, or wherever current consumption is greater than the ordinary receptacle is adapted to carry. The plug is non-reversible.

Fig. 12 is a flush receptacle of the universal type, manufactured by the Duncan Manufacturing Company, of Montreal. This is a very neat appearing plug.

Fig. 13 is another type of Duncan flush receptacle, which takes the same plug as Fig. 12, and is also made to fit standard metal boxes.

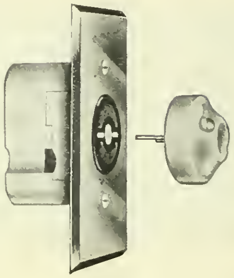


Fig. 13

Fig. 14

Fig. 14 is another form of Bryant receptacle, known as the Old Style Chapman.

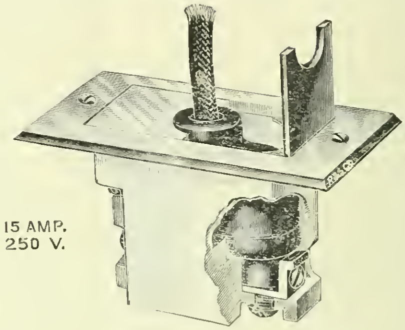


Fig. 15

Fig. 15 is another type of receptacle manufactured by Russell & Stoll. This consists of a heavy porcelain receptacle, taking a heavy composition plug, which is entirely flush with the plate when in use.

Fig. 16 is one of the types manufactuerd by Harvey Hubbell, Inc., Bridgeport, Conn. This represents a new line with a small cap.

Fig. 17 is another type of receptacle manufactured by Russell & Stoll. The body of the receptacle and the plug are made of heavy porcelain mounted in a cast iron box with a brass plate.

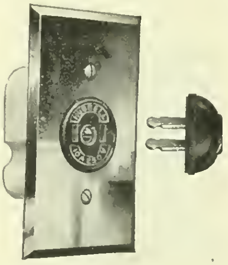


Fig. 16

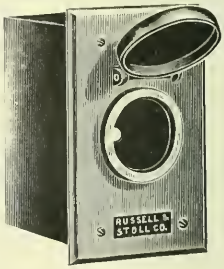


Fig. 17

Fig. 18 represents another type of Hubbell receptacle, very similar to Fig. 16.

Fig. 19 is another form of the Chapman receptacle, manufactured by the Bryant Electric Company. Fig. 28 represents a plug withdrawn.

Fig. 20 is a high capacity, disappearing door receptacle of the Bryant type. This has a capacity suitable for heaters, moving picture machines and other portable current con-

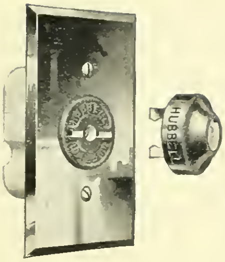


Fig. 18

Fig. 19

suming apparatus requiring a large amount of current. The design is the same as that shown in Fig. 7.

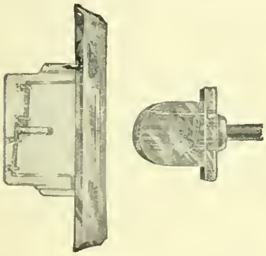


Fig 20

Fig. 21

Fig. 21 is a screw plug type manufactured by the Harvey Hubbell, Inc. When the plug is removed the door fits down snugly, so as to present a flush surface.

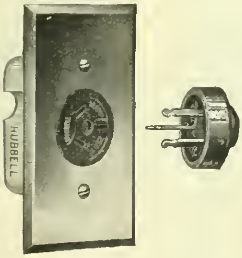


Fig. 22


Fig. 23


Fig. 24

Fig. 22 is another form of Hubbell receptacle and plug for three-wire supply. The plug is so designed that it cannot be wrongly inserted.

Fig. 23 illustrates a Canadian General Electric receptacle, made to take any standard Edison screw attachment plug. This is furnished complete with a cast face plate, and in the design of the mechanism attention has been paid to making the connecting posts as accessible as possible, permitting a maximum saving in time and wiring.

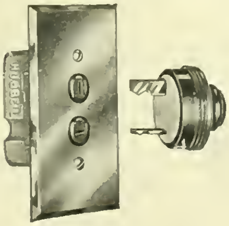


Fig. 25


Fig. 26

Fig. 24 is one of an extensive line of separable devices, all interchangeable, manufactured by the Canadian General Electric Company. The design of the contact fingers in all these devices is unique, and makes for an unusually reliable connection.

Fig. 25 is still another form of Hubbell receptacle. This is known as a polarity type, with knife-blade contacts set at right angles. This type is designed for use where it is desirable or essential not to change the polarity.

Fig. 26 is a circular type of flush plug, also of the Hubbell manufacture.

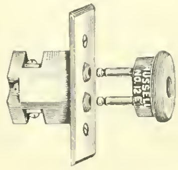


Fig. 27


Fig. 28


Fig. 29

Fig. 27 is an extra heavy type of plug, made by Russell & Stoll. The body is of heavy porcelain and the plug of extra strong moulded composition.

Fig. 28 represents the plug used in connection with the Bryant receptacle shown in Fig. 19.

Fig. 29 represents another type of flush receptacle manufactured by the Bryant Electric Company.

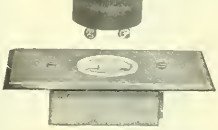


Fig. 30

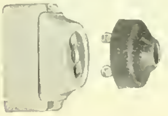


Fig. 31

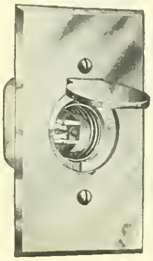


Fig. 32

Fig. 30 illustrates the larger type Cutler-Hammer design of baseboard receptacle handled in Canada by the Benjamin Electric Manufacturing Company.

Fig. 31 is a smaller type of Cutler-Hammer design.

Fig. 32 is a screw type receptacle manufactured by the Trumbull Electric Manufacturing Company. When the plug is removed the door fits down neatly, making the receptacle dust and water proof.

Trade Enquiries

Name and address of inquirer may be obtained on application to the Electrical News, Toronto.

887. **Engines and boilers.**—A firm in Johannesburg with branches throughout the Transvaal, Free State and Natal, desires to receive catalogues, quotations and full particulars from Canadian manufacturers of small portable engines and vertical boilers, in capacities of 2, 4, 6 and 8 h.p., suitable for small irrigation plants and general farm purposes. Quotations preferred f.o.b. Montreal and St. John.

The operation returns of the municipal street railway, Regina, for the week ending August 15th are as follows: revenue $3,230.05; passengers carried, 79,998. For the week ending August 22 corresponding figures were $3,779 and 86,933.

New designs in Busbar Supports

The following description, by the General Devices & Fittings Company, Chicago, of new designs of busbar supports and special porcelain recently placed on the market by that company, is of interest.

"The first and most important feature of the bus bar supports is the design of the porcelain part. In designing this part great care was taken to produce an even distribution of stresses and strains over and throughout the porcelain parts. The voltage requirements for safety factor and the results of flash over and arc over tests were given great consideration. It is well known that a certain piece of porcelain will arc over before puncture. It is not generally known, however, that cases exist where this particular piece of porcelain should puncture before flashing over.

"With the new high frequency testing equipment we are able to absolutely determine where a piece of porcelain should be reinforced or the dielectric decreased. This means that some porcelain should be reinforced at the voltage point and weakened at the ground point, and other porcelain of similar nature should be reinforced at both points. These points were discovered through the aid of high frequency and we can state unreservedly that we believe this one feature is without doubt the greatest advance that porcelain design has received in years.

"Many tests and careful investigation of the use of cement in any form with porcelain has led us to adopt mechanical cushioned clamps throughout our entire line. The dielectric change in porcelain due to the use of cement is understood to-day as being one of the factors that causes aging and fatiguing of porcelain carrying large currents, and this is the subject of a world-wide ceramic study of the best engineers. This company is offering a product in porcelain entirely different from anything on the market.

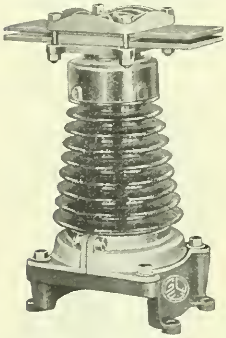


Fig. 1.

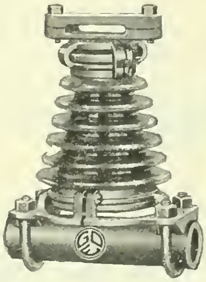


Fig. 2.


Fig. 3.


Fig. 4.


Fig. 5.


Fig. 6.

"Our patented pyramid type porcelain bus supports are designed with small thin corrugations beginning at the voltage point and tapering wider and deeper to the ground point primarily to reduce the electrostatic field. This patented feature was brought out after a long series of tests and investigations to the end that a product could be produced that would give long life with the highest possible maximum of safety and the least minimum of expense.

"Engineers are aware of the cost of up-keep and maintenance of porcelain now installed through constant replacement and renewals. We could cite innumerable cases of complete shutdowns and outages due to porcelain entirely. We offer a safety factor of 4½ to 12 times, depending upon the service voltage impressed on the porcelain part; the larger the kilowatt capacity being supported the greater should be the safety factor and the more rigid the support to take care of this feature.

"It is interesting to note that bus bar equipments in certain plants have shown, by careful test, that they are subject to a magnetic pull as high as 455 pounds per lineal foot of bus. It is therefore obvious that proper bus supports should be specified to take care of these situations, knowing that this magnetic pull will be increased tremendously through a short circuit, motorizing, inductive troubles, etc. Many of our larger plants are trying to reduce this liability by the use of reactances, which are furnished for generator, bus bar and feeder service. The generators can be wound with a pre-arranged percentage of reactance and have also an outside reactance as well. When we consider the enormous strain that is placed on bus structures through short circuits we naturally inquire where the strain comes from. The ratio of full load to short circuit on turbine driven generators without reactances would in no case be less than three times and might be as high as fifteen times, depending upon the size of the unit and its regulation. With these facts before them engineers are now taking great pains with their bus bar equipment, and especially the supports for the same.

Referring to the cuts attached to this article, Fig. 1 shows a bus bar support for 22,000 volts with a guaranteed test, all assembled, of 112,000 volts. This support carries a ceramic factor of 1.29, which is over 60 per cent. greater than any support on the market. This support is set on an insert which was designed to be molded into the concrete floor of compartments. This is one of this company's patented features and is original with us. All hardware, excepting the insert itself, is made of hard bronze. This bus bar support will hold a strain exceeding 1,200 pounds per square inch. The cut shows two laminations of ¼-in. bus bars with one filler. These supports are designed to hold any size or capacity of bus bar.

Fig. 2 shows a standard bus bar support equipped for holding flat buses on the horizontal and for mounting on pipe frame, this support having two "U" bolts.

Fig. 3 shows a bus bar support for supporting buses in vertical position and for mounting on pipe frame. This pipe frame support has a set screw in the lower clamp to prevent the support from turning on the pipe and is used where supports like Fig. 2 are too wide for close work.

Fig. 4 shows a bus bar support for mounting buses in a vertical position with a flat base and centre bolt clamping arrangement. It is a very popular support for medium-sized bus bar equipments. It can be slipped over a bolt which has been imbedded in the concrete structure and turned in any position.

Fig. 5 shows a bus bar support carrying a round bus of any description. It is shown with a skeleton type base for mounting on flat surface. This base is very popular and much in demand.

Fig. 6 shows a bus bar support for holding large insu-

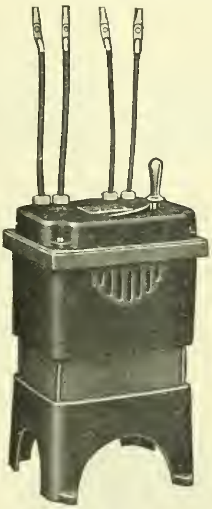
lated cables or bare cables as the case may be, and is shown with a compartment type base. This enclosed base is hollow in the bottom and drops over a stud, which may be cemented in the compartment floor, and is much in demand where height is limited.

All the above supports can be furnished with any of the bottoms or any of the tops, to suit conditions. Fig. 1 support can be furnished either as a double support, three-way or four-way support, and arranged to carry buses on the vertical, on the horizontal, or special tubular buses, and all supports can be adjusted to any angle by simply unloosening clamps.

The Compensarc for Moving Picture Machines

One of the most difficult problems connected with the moving picture business is the management of the light for the machine. This not only determines the amount of one of the largest items of expense but also influences the popularity of the show. A theatre will not be patronized unless it supplies good pictures and since the quality of the pictures depends upon the light as much as upon the film itself it is necessary to secure a perfect light at a minimum cost.

Moving picture lamps require only about 35 to 60 volts at the arc, while most commercial lighting circuits supply a voltage of either 110 or 220 volts. Some device must of necessity, therefore, be used between the line and the lamp



The Compensarc

to take care of this difference in voltage. Formerly iron-wire or grid resistance rheostats were used. Their use, however, resulted in an actual waste of all the energy supplied from the line over and above that required by the lamp. They also generated so much heat that they not only made the operating room like an oven, but were liable to set fire to the films or other inflammable material.

A device called a compensarc, supplied by the Canadian General Electric Company is claimed to overcome these difficulties by reducing the current without needless waste or generation of heat. There are two kinds of compensarcs—one for alternating current only and one for direct-current only. They are entirely different in construction and operation, but their purpose is identical and they produce practically the same results. The alternating current compensarc is rated at 2 kw. for 110 volts or 2½ kw. for 220 volts and wound for either 60 cycles or 133 cycles, as may be desired. Its general appearance is clearly shown in the illustration. The core is made of the highest grade sheet steel laminations, similar to standard transformer construction. The outer surface of the core is fully exposed to the air. The coils are mounted within the core and are completely protected and thoroughly insulated. Core and coils are given vacuum treatment, making them moisture and waterproof. A horizontal, three-step, continuous circuit switch is mounted on the slate top, providing three adjustments for intensity of light. Each adjustment is so designed that it maintains approximately the same voltage at the arc while passing from one step to the next, without at any time opening the circuit which would consequently break the arc and produce flickering.

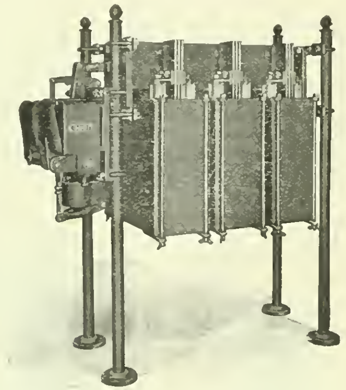
The compensarc is claimed to be the only device which is adjustable without breaking the circuit between adjustments. There is no waiting for the arc to settle and become steady before the intensity of the light can be determined. It increases or decreases the intensity of light without a flicker. In actual operation it has been found to effect a saving of one-half to two-thirds of the operating expenses and at the same time produces a much better light for the picture.

Condit Type "Y" Oil Circuit Breaker

Owing to the unsatisfactory operation, due to the excessive burning of the contacts and the enormous rise of potential at the instant of opening, on carbon-break circuit breakers of large current-carrying capacities on alternating-current circuits, there has been a demand for an oil-break circuit breaker for such service. The Condit Electrical Manufacturing Company offers such an oil circuit breaker in its type "Y." The illustration shows a 2,000 ampere, 3-pole, electrically-operated, Condit type "Y" oil circuit breaker. This type of breaker is also made in capacities up to 6,000 amperes and 3,300 volts.

The stationary current-carrying parts of the Condit type "Y" oil circuit breaker consist of laminated copper bars, securely fastened to wet-process porcelain insulators and carrying on the lower ends of the bars heavy, massive copper blocks on which contact is made. The upper ends of the laminated bars extend through the switch frame and form the laminated terminals to which the conductors are fastened, this type of terminal construction being standard, although when necessary the terminals may be arranged for cable connection. The moving contacts consist of the standard Condit laminated brush which in its closed position spans the space between the stationary contacts. The brush is made in two parts, each part bearing on the stationary contacts. Owing to this method of construction, the strain on the porcelain insulator is equalized and, furthermore, the arc is divided into four parts in each oil tank, or eight parts per phase, thus materially increasing the current-rupturing qualities of the circuit breaker. The brush is so mounted on its supports that it is self-adjusting in position on the stationary contacts. Each brush is composed of a number of laminations so arranged that each lamination makes individual contact, but is also separated from the adjacent laminations by a space at the point of contact. This space allows for free circulation of oil between the brush laminations and also permits the brush to be made with a steep angle of contact, thus giving a long, wiping, inherently self-cleaning action in contradistinction to the dead action of the ordinary "butt on" brush. While this brush is capable of successfully opening considerable energy without injury, the construction of the apparatus is such that the brush is not required to perform any other function than that of carrying the current. All arcing, in either making or breaking the circuit, is taken care of

by heavy auxiliary contacts of special non-arcing metal, which make contact before and break contact after the laminated brush has left the stationary contacts. The brushes are mechanically connected to, but electrically insulated from, the operating mechanism, by strong, impregnated wooden rods. The arc is broken near the bottom of the oil tank, and, consequently, under a high head of oil. It is well known that when an arc is formed in oil it is vaporized at an extremely high temperature. The gases which are formed, due to this vaporization, are forced to travel upward through this high head of oil and in so doing are greatly cooled, thus reducing to a minimum the danger of an explosion in the gas dome over the oil line. The safe operation of this breaker is further increased by the introduction of a deflector plate, so designed as to prevent the throwing of oil from the oil tanks when the arc is broken, while at the same time no opposition is afforded to the free movement of the gases of vaporization.



Large capacity circuit breaker

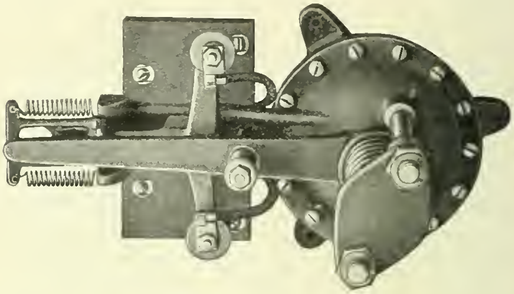
The oil tanks in this breaker are also of noteworthy construction. In many cases the oil-containing vessels of a switch are its weakest point, and many disastrous failures may be traced to the destruction of the oil tanks. The oil tanks on this breaker are exceptionally strong. They are rectangular in shape and are made of heavy 3/16-in. thick, electrically-welded sheet metal, absolutely without joints and equally strong in all parts. The tanks are lined with an especially prepared insulating material.

The operating mechanism is simple, strong and rugged, and so designed that the maximum closing force is applied at the contacts, with the minimum expenditure of energy at the operating handle. In the hand-operated type, the circuit breaker is operated by a simple in-and-out movement of the handle. The stationary contacts are mechanically supported by, but electrically insulated from, the main frame by porcelain bushings which in turn are fastened to the main frame by means of clamps, without the use of any babbit or cement. Such a construction tends to simplicity and ease of assembly and adjustment, or removal in case repairs are necessary. The porcelain bushings used are all in one piece and of wet process porcelain. Wet process porcelain will stand a higher puncture test than any other type of porcelain.

These breakers are furnished either hand or electrically operated. In the latter case, electro-magnets are employed for operation. The operating magnets may be placed above, below, or in the rear of the circuit breaker, the particular location depending entirely upon the local conditions incident to the installation of the apparatus. The breaker is designed for pipe-frame mounting in both the hand and electrically-operated types, and is designed to carry its rated current with a temperature rise not exceeding 30 deg. C.

New Double Pole Pressure Regulator for Starting and Stopping Small Motors

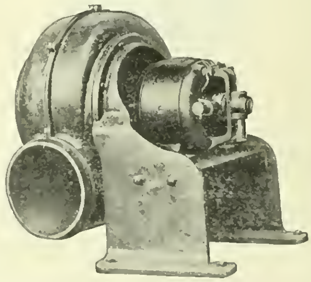
The double pole diaphragm type pressure regulator illustrated below is a new device for automatically controlling small direct or alternating current motors operating on pressure systems. This regulator stops the motor when the maximum pressure desired is reached and starts it again when the pressure drops to the low value for which it is set. For capacities within the limits for which it is designed (1 h.p. for d.c. and 5 h.p. for a.c. motors) this regulator controls the operation of the motor without an additional magnetic switch and automatically maintains pressure in the systems between given limits. It is made by The Cutler-Hammer Manufacturing Company, of Milwaukee.



Double pole pressure regulator

A New Line of Small Ventilating Outfits

The Westinghouse Electric & Manufacturing Company announce that they have placed on the market a new line of small ventilating outfits for use in moving picture theatres, restaurants, hotels, bakeries, laundries, stores, offices, public buildings, etc. The line includes two types—Ventura fans and Sirocco blowers. The Ventura fan is suitable for mounting in the wall and handling large amounts of free air. The fan differs from the ordinary type in having a larger number of blades which are mounted on a large central disk and have the ends abruptly turned up. This form, it is claimed by the manufacturer, operates very quietly and with high efficiency. The air is thrown from directly in front of the fan, instead of being widely spread out, and no back flow is possible through the centre of the fan. The unit is especially compact and the motor protrudes very little into the room. Great pains have been taken to make the finish attractive. The motor is a special type, wholly enclosed and



Sirocco ventilating blower

with a thrust bearing. It has ample overhead capacity to drive the fan with a strong back-pressure of wind against it.

Sirocco blowers are designed for use with systems of piping or where some resistance is offered to the passage of the air. They are used for ventilating inside or underground rooms, bank vaults, cabins and engine rooms of steamers and yachts, lavatories, telephone booths, etc. They are also adapted for many blowing operations, such as for air baths, aspiration, removing chips, and so forth. The essential parts are the motor, a sirocco blower wheel mounted on the motor shaft, a cast-iron housing to direct the air current, and a supporting base. The blower wheel is a distinctive feature. It has from 36 to 64 narrow blades and an unusually large air outlet, which reduces eddy currents to a minimum. Air is discharged at an unusually high velocity. The blower housing can be revolved and reversed so as to direct the discharge horizontally to either side or vertically up or down. A screw driver is the only tool needed to make the adjustments.

Wireless Receptacles

Paiste wireless plug-receptacle and W. P. lamp-receptacle are now being manufactured for use in pipe taplets. No tap wires are required, the main wires being bared for half an inch and fastened directly to the binding screws of the fittings. There is plenty of room under the base for a third wire. The base is the same for both the plug and lamp receptacles, so the caps can be interchanged without taking the base from the taplets. In the lamp receptacle, the screw shell and the

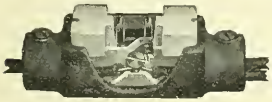


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1.—Pipe taplet cut away showing wiring of base of wireless plug and W.P. lamp receptacles. Fig. 2.—Wireless plug receptacle No. 4254 on type "C" pipe taplet. Fig. 3.—Wireless lamp receptacle No. 4251.

contact button are both fastened to the cap instead of to the base. This gives a very rigid receptacle as the cap is screwed directly to the pipe taplet. As both ½ and ¾ in. taplets have the same size opening only one size of receptacle is needed for both sizes of conduit. For waterproof work a rubber gasket is furnished for the screw shell receptacle, and as the base of the receptacle is sealed it is waterproof in every respect. The Hart & Hegeman Manufacturing Company, Hartford, Conn., are now sole selling agents for Paiste material.

Dominion Bridge Gets Orders

The municipality of the city of Winnipeg have awarded the contract to the Dominion Bridge Company for steel for their special towers on their new transmission line. These towers are for special river and railway crossings, which part of the work it is the intention of the city to complete at once. The footings, both steel and concrete, are more than half completed for the new line, but the bulk of the towers, which will be of flexible design, will not be ordered this year.

Pass & Seymour, Inc., announce that they have prepared complete Spanish and Portuguese literature describing their products. This is in view of the change taking place all over America in trade conditions. The Pass & Seymour Company is showing itself aggressively alive to the value of the South American trade. We understand that other companies are following a very similar course.

The Nineteenth Annual Convention of the International Association of Municipal Electricians will be held in Atlantic City, N.J., September 15th to 18th. Space will be provided for those wishing to exhibit electrical material and devices. Important papers will be presented covering subjects of interest to municipal electricians and those interested in electrical affairs.

The Trumbull Electric Manufacturing Company, Plainville, Conn., announce that they are now manufacturing armoured cable, flexible conduit and armoured flexible cord. This material will be high-grade in every particular. The Trumbull Electric Company purchased the machinery and patent rights from a former manufacturer and will manufacture the above in their own factory under improved conditions.

Trade Publications

Circuit Breakers—A folder issued by the Transmission Engineering Company, of Pittsburgh, Pa., describing and illustrating their weatherproof oil circuit breakers for 2,500 volts.

The Electrical Apparatus Company, Limited, London, England, have issued the following publications.—Leaflet H 16, describing and illustrating their standard type direct-current motor starters; leaflet H 42, describing auto-transformer starters of the drum type; leaflet H 47, giving dimensions and shipping particulars of their air-brake and auto starters; and publication No. X, describing E.A.C. high torque meters for house service.

Patents, Designs, and Trade Marks—A booklet specially prepared for the guidance of inventors and manufacturers making application for patents, etc., by Stanley Lightfoot, registered patent solicitor and attorney, Toronto, and Washington, D.C. This booklet is written in a clear and concise manner, is well arranged for easy reference and explains in simple language many important points which are often confusing to the inventor.

Canadian Westinghouse—The Canadian Westinghouse Company, Hamilton, Ont., are distributing the following publications:—Cooking Breakfast at the Table, a one act true-to-life sketch describing the wonderful conveniences and labor-saving qualities of the electric toaster stove and percolator; Westinghouse Wicker Type Electric Linotype Pots; Motor Driven Pumps; Type T Direct Current Turbo Generator; and Storage Battery Locomotives.

Canadian General Electric Publications—Exide Battery for Electric Vehicles, bulletin section X, describing Electric Storage Battery Company's batteries for electric vehicles; Accumulators, bulletin section A, describing Electric Storage Battery Company's Chloride and Tudor accumulators for electric railway service, central lighting and power plants, isolated light and power plants, interlocking switch and signal service, telephone, telegraph, fire alarm, laboratory and small motor work; Railway Condulets, describing different types; Crane and Hoist Motors, describing commutating pole, direct-current crane and hoist types; Labor Saving H. & H. Wall Cases; Electrocurl, describing a self-heating electric curling iron; Eveready Portable Lights, giving description and prices of Eveready mazda lamps and Eveready tungsten batteries, made to work together; Xceladuct and Orpenite Conduits, giving description and prices of copper plated galvanized and enamelled conduits. These publications are all very thoroughly illustrated.

Current News and Notes

Campbellford, Ont.

The Northumberland Pulp Company have placed an order with the Boving Company of Canada for two additional hydraulic presses.

Fort William, Ont.

The net earnings for the first eight months of the present year of the Kaministiquia Power Company are announced as $185,295, with a surplus for the same period of $126,479.

Montreal, P.Q.

Consequent upon the difficulty of securing funds, the Montreal Board of Control have decided to postpone the scheme of street lighting for St. Catherine Street, plans for which were prepared by Mr. Parent, the civic superintendent of lighting. The Board also decided not to award contracts for the new fire alarm system, the wires for which were to have been placed in the conduits.

Newmarket, Ont.

Mr. F. A. Gaby, chief engineer of the Hydro-electric Power Commission of Ontario, recently addressed a meeting of about 500 interested ratepayers in Newmarket. Mr. Gaby explained the advantages of hydro service and the great possibilities of the radial lines proposed to be installed by his commission. Apparently the hydro radial scheme is being endorsed enthusiastically all through this district.

Peterborough, Ont.

Street railway extensions planned by the Radial Railway Company are being held up temporarily, pending paving operations, which have also been postponed by the city.

It is understood that the order to expropriate the Peterborough Light & Power Company, which the city of Peterborough has asked for, has been signed. The city will pay the company the sum of $100,000.

Port Arthur, Ont.

Messrs. J. J. Hackney, commissioner for the city of Port Arthur, and A. McNaughton, superintendent of light, power and railways for the city of Fort William, have been appointed a committee to consider the advisability of increasing the rate of ordinary tickets of the street railway system from six for twenty-five cents to five cents straight. This would not interfere with children's or working men's tickets, and, it is calculated, would result in a 20 per cent. increase in revenue.

Regina, Sask.

Under the provisions of the Rural Telephone Act His Honor the Lieutenant Governor by and with the advice of the Executive Council has ordered that approval be granted to the Raymore Telephone Company to incorporate as a joint stock company under the Companies Act.

The following rural telephone companies have been incorporated in Saskatchewan: Glenford Rural Telephone Company, Limited, Glenside; Schneider Rural Telephone Company, Limited, Weyburn; Kingsley Rural Telephone Company, Limited, Windthorst; Luton Rural Telephone Company, Limited, Dubuc.

Renfrew, Ont.

Telephone communication has been established between Pembroke and Allumette Island, Chapeau and Chichester by cable across the Ottawa River.

Sarnia, Ont.

The Sarnia Gas and Electric Company have placed an order with the Canadian Westinghouse Company for a 1,000 kw. turbo-generator.

Saskatoon, Sask.

When the Saskatchewan Government took over the telephone system in 1908, there were only 497.2 miles of long distance pole line in the province. At the end of April, 1914, this mileage had been increased to 3,393.17, connecting up three hundred towns and villages in the province and enabling communication with over 17,000 local subscribers and 7,989 rural subscribers. By the end of the present season a further remarkable extension of lines will evidence the activity of the provincial department.

St. Catharines, Ont.

It is reported that the Marathon Tire Company have undertaken to equip their factory with electric machinery and have promised to purchase power from the city council.

St. Marys, Ont.

At a recent meeting of the Water, Light and Heat Commission, it was decided that the present time is not opportune for undertaking a complete new street lighting installation. In the meantime the small lamps on the main streets will be replaced by much larger ones, and it is believed the town will be sufficiently well lighted for the coming winter.

St. Thomas, Ont.

The Hydro-electric Commission of St. Thomas announce that they have added 231 consumers during the last seven months.

It is understood that the installation of a new street lighting system on Talbot street will be proceeded with without delay.

Owing, it is said, to the financial stringency, work will be temporarily delayed on the electrification of the London and Port Stanley railway system.

Toronto, Ont.

The Electrical Workers' Society have appointed a committee to deal with the matter of making provision for the dependents of such of their members as have already gone, or may go, to the war. It has been agreed to keep the fees of these members paid up and to maintain their standard for sick and funeral benefits.

Walkerville, Ont.

It is claimed that local applications for hydro service have been coming in at the rate of about ten a day since it was announced that the contract has been closed for the purchase of the local system by the municipality.

Wingham, Ont.

It is said that the farm of Reeve Bissett, of Colborne Township, is now considered the most modern dairy farm in the district, on account of the installation of electrical equipment operated by Niagara power. Mr. Bissett has installed milking machinery, motors for cutting and storing ensilage, pumping water and operating other machinery about the house and buildings. The farm comprises 600 acres of land and 60 cows are at present milking night and morning.

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Generation, Transmission and Application of Electricity

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 23 Toronto, October 1, 1914 No. 19

The "Good Lighting" Season

Every year at this season, as the evenings begin to lengthen, the attention of Canadians is necessarily drawn more forcibly to the need of good illumination. Living in a comparatively high latitude, and spending, in consequence, so many more hours each day under artificial light than our neighbors to the south, it is all the more necessary, taking into consideration the evil physiological and psychological effects of bad lighting, to say nothing of the reduced quality and quantity of work we can turn out, that we take extraordinary precautions to have our illumination installations more carefully made and more scientifically installed than those countries which are more fortunately situated in the way of a larger total number of hours of daylight. Instead of leading in the matter of good illumination, however, it cannot be contended that Canada is even holding her own with many of those countries whose need is much less urgent. Our methods of illumination have been both crude and inadequate, and where others have been actively awake to the physical and industrial advantages of all the modern developments in illumination, and scientifically active in pursuing the study of the art of illumination, so that still better results may be obtained, Canada has been satisfied, except in a few isolated instances, with lighting installations, both public and private, of a type discarded by our neighbors many years ago.

It is with the hope that we may have some little influence in improving these conditions, through expressing the views of engineers and others who specialize in illumination installations, and through descriptions of what other countries, in advance of us, are doing, that we publish each issue a section on illumination, and each year at this time, a special illumination number. In the present issue will be found articles on many topics of everyday and vital importance—factory lighting, street lighting, house lighting, glassware, distribution methods, etc. None of these are intended to cover the subject completely, but all of them, it is believed, will assist in adding something to Canadian productiveness, comfort and happiness. The value of proper illumination is each day becoming more distinctly understood; the means of providing it is already, to a very satisfactory degree, available. Is it not our duty to take advantage, to the fullest extent, and without further delay, of all that science has already accomplished? At a little later date may we not also hope to do something, by way of study and research, towards adding to the sum-total of human knowledge on this important subject?

The Middle Course

Our Minister of Finance, Hon. W. T. White, in his recent public utterances, has voiced the exact sentiments of the more thoughtful of the Canadian people, when he counsels that municipalities, railways and big industrial concerns should steer a middle course in carrying out their programmes of expenditure in the immediate future. Mr. White evidently has no sympathy with those manufacturers and others who, at the first sign of trouble, summarily dismiss their loyal employees, and close and bar their doors, thus accentuating the very difficulties others, more loyal and sane, are endeavoring to forestall. This form of "Shylockism" ill befits those who have profited for many years by one form or another of government protection.

The middle course has already proven an eminently fair and sane one for business men throughout the Dominion to follow. A readjustment is evidently even now taking place. As Mr. White says, the first and the worst effects are gradually wearing away. Many of our industries have suffered, but on the other hand, many have been greatly quickened and stimulated. The higher prices for grain and other agricultural products will more than neutralize the shortage in amount. Increased agricultural production will be inevitable, and this has been the great need in Canada for many years back. This will help to solve the problem of the high cost of living, with its coincident evils, the overcrowding of cities and consequent unemployment. As a result of the scarcity of certain raw materials, new industries will spring up, and with the demand for manufactured products, which Europe cannot hope to supply for many months to come, Canada now has unexpectedly opened to her the means of becoming recognized throughout the world as a manufacturing centre. The first duty of every Canadian is to put forth his utmost effort to increase production and to add to the national wealth, not only that the wastage of war may be repaired, but also that the opportunities offered by the conditions which the war produces may be taken advantage of to their fullest extent.

A Canadian Illuminating Society

In spite of tremendous advances made in the last few years, there is yet a vast room for improvement everywhere, and in Canada particularly, in what may be called the "field of proper illumination."

Past progress in the illumination art is the result of individual effort. The lamp manufacturer has produced a well-nigh perfect lamp; same with the glass manufacturer. The central station is giving far cheaper current. The contractor is wiring his buildings safely and completely. The architect is developing the decorative side, but there lacks—

co-operation. The glass man has his own idea—he wants to sell glass; the lamp man wants to sell lamps; the manufacturer of brass wants to sell brass; the contractor wants to do plenty of wiring regardless of all the others; the central station wants to sell current. But individual play has its limitations. It is team work that wins the pennant. So, if we are to advance further in Canada towards that all-important goal—correct illumination—the various units must work together.

Before they can work together, however, they must get together—manufacturer, architect, dealer, engineer, contarctor, jobber, decorator, ophthalmologist—get together and discuss ways and means of producing better results, meet on common ground and each express his own point of view, so that the present illuminating industry, a heterogeneous and more or less chaotic muddle, may become transformed into a homogeneous, perfect unit. The need of some kind of an organization among illuminating interests was felt a few years ago in the United States, and the result is to-day a very powerful and influential society, which has been the means of improving beyond conception the standard of illumination of that country. A few, very few, Canadians have taken advantage of the opportunity of becoming members of this society and have derived very great benefit therefrom. The London (Eng.) Illuminating Engineering Society, operating along similar lines, has also proven a great success. Our apparent need to-day is a Canadian Illuminating Society where anybody interested in better illumination (which means everybody) may meet together for mutual benefit and enlightenment. The field for such a society is wide and open. The material is ample and ready to hand. Can we not have a Canadian Illuminating Society and improve illuminating conditions right away?

The Lamp Situation and the War

One of the most inconveniencing possibilities of the European war would be a shortage in incandescent lamps, though danger in this respect appears to be remote. Lamp manufacturers of North America have, it is true, been more or less dependent for their supply of glassware on Germany and Austria, which countries have long been recognized as the seat of the glass-blowing industry. This continent has been growing more independent, however, in this respect, and in recent years the quantity of home blown glass has been greatly increasing. Indeed we understand that at least one large lamp factory in the United States blow practically all their own bulbs, and the exigencies of the present situation will no doubt serve as a general stimulus to this phase of the glass industry.

A somewhat unfavorable item in the glass situation is the fact that certain of the chemical ingredients required in the manufacture of the various kinds of glass have also been imported from Europe; to what extent this loss can be made good from other sources has yet to be determined. Another item to be considered is that the blowing of glass is an art not easily or quickly acquired. The continentals have become perfect in this art through centuries of painstaking, intelligent concentration, so that the influences of heredity are added to the natural adaptability of the German and Austrian glass blower. For these reasons, it is doubly difficult to duplicate this merchandise in Canada or the United States, and impossible to do so except at greater cost.

Fortunately, however, a very large percentage of our lamps have been coming from Holland and England, and all orders placed with these countries are, so far as we can learn, being accepted without hesitation. Indeed shipments are already to hand for which orders were placed since the war began. In certain quarters it was feared at first that the home demand in England, deprived of the imported supply, might mean the shutting off of a part of their export, and that Canada would suffer thereby. This however has not been the case.

So far as price is concerned, there is no immediate danger of any marked advance. A manufacturer here and there has added a cent or two per lamp to cover extra contingencies, but the price to the consumer in all cases remains the same, and, in most cases, to the dealer. Taken altogether, therefore, the incandescent lamp situation in Canada remains practically undisturbed by the European war.

A prominent Canadian manufacturer discusses the situation as far as his company is concerned, as follows:—In the past we purchased very few lamp bulbs of foreign manufacture, as from past experience we found that we could not get the bulbs uniform, and in order to get a first class article we have been purchasing the greater part of our bulbs from United States manufacturers at an increased cost over those of foreign make. To take care of our regular heavy fall trade we have on hand a large quantity of bulbs and a fair stock of all staple types of carbon and mazda tungsten lamps sufficient to take care of our regular trade.

We have a large stock of tungsten metal and we do not anticipate any difficulty in getting a further large supply. Tungsten is used to a great extent in the manufacturing of steel and can be purchased in large quantities from practically any country in the United States. I also understand that it can be secured in Canada.

We are doing our own refining and also drawing our own wire. We do not anticipate any difficulties in securing raw materials necessary for the manufacturing of various types of incandescent lamps.

We a short time ago advised all of our contract customers that we are prepared to furnish them with the full quantity of lamps called for on their contract, at no advance in price. We will no doubt be called upon shortly to furnish large quantities of lamps to take the place of those formerly imported from foreign countries. Having recently imported from foreign countries. Having recently made large additions to our plant, doubling our capacity, we are prepared for a very large increase in business. Our busy season is now close at hand and we are prepared to give our usual efficient service to all of our old customers and are making arrangements to give the same efficient service to any new trade we may be favored with. In order to do this it may be found necessary to run a night shift. With this in view we are arranging to train new help.

We are indebted to the office of the Chief Trade Statistician through Mr. F. C. T. O'Hara, deputy minister of the Department of Trade and Commerce, Ottawa, for the following information regarding the importation into Canada of material required in the manufacture of incandescent and arc lamps.

Imports of Undermentioned Goods into Canada

(Year ended March 31, 1914)

Incandescent lamp bulbs and glass tubing for use in the manufacture of incandescent lamps and mantle stocking for gas light:—

From Austria-Hungary	$13,000
Belgium	40
France	1,824
Germany	4,128
United Kingdom	1,491
United States	110,049
Total	130,532

Metallic elements and tungstic acid when imported by manufacturers for use only in their own fac-

tories in the manufacture of metal filaments for electric lamps:—

From Austria-Hungary	$ 1,748
United Kingdom	28
United States	44,120
Total	45,896

Electric light carbons and carbon points of all kinds:—

From Austria-Hungary	$ 587
Belgium	222
France	633
Germany	43,308
Switzerland	2,491
United Kingdom	5,247
United States	37,368
Total	89,856

The imports from Germany alone to Canada of lamps of different kinds also follow:

Classification	Number	$
Arc lamps	164	2,618
Metal thread lamps	502,533	130,186
Electric incandescent lamps, N.E.S.	296,535	25,704

Gas Filled Tungsten Lamps in Chicago

On August 18th a circuit containing 240 4-ampere 75-watt series nitrogen-filled tungsten lamps was put into operation in the Ravenswood district, Chicago. On August 27th a circuit of 132 20-ampere 300-watt series nitrogen-filled lamps was turned on in the south side district. The latter is claimed to be the more noteworthy installation, because all indications seem to show that the performance of these lamps will fully equal, if not exceed, in all respects, including actual cost and equivalent illumination, the results obtained with the flaming arc lamps, which have been the standard street lighting units in the city of Chicago.

Within the past two weeks seven additional circuits have been put in service, bringing the total number of 300-watt nitrogen-filled lamps in use on September 8th to 728. It is said that more are to be added from time to time, so that, before many months, Chicago will be using up to 15,000 of these new units.

The fixtures with the nitrogen-filled lamps closely resemble the flame arc equipment in appearance. Instead of the arc mechanism there is a comuensator furnishing 20 amperes to the lamp from the 10 ampere line circuit. The compensators have an extra tap to permit their use on 6.6 ampere circuits, the lamp current in this case to be 20 amperes also. The outer diffusing globe is of Alba glass. Within this globe some of the lamps are being equipped with a special refracting globe made of two cup-shaped prismatic glass globes, sealed together with the prisms on the inner surface to protect them from dust, the outer surfaces being smooth. This refractor is intended to give a greater lateral distribution of light.

Service is from overhead wires. The lamps are mounted on tubular steel poles with the centre of the lamp 22 feet above the street surface. For cleaning and renewals the lamps are lowered to the ground, the lowering rope passing up through the pole after the lamp attendant has attached an extension rope. In the later installations the lamps are placed from 160 to 250 feet apart, depending upon the requirement of the street.

It is said that the light furnished by the new lamps is very pleasing in color and steadiness. The outer globe is uniformly luminous and gives a nearly white light. The density of the globes and the height of the lamp are sufficient to reduce the glare to a minimum. The light is very steady compared with the flame arcs. Tests have not yet been made to distinguish the relative distribution effects with and without the special inner refracting globe. The new lamps give an average maximum of 600 c.p. with 300 watts consumption. Tests shows that, in the earlier part of their life, the c.p. increases slightly, and this gradually diminishes, so that the average c.p. during rated life shows very little variation from the normal rating. Taking into consideration electrode and lamp renewals, cost of trimming and cleaning, cost of current, etc., it has been found by the city engineers that the cost of maintenance for the two types of units (mazda and arcs) will be practically equal for equal illumination, if the nitrogen lamps have the 1,000 hours of rated life which the manufacturers guarantee. A prime advantage claimed on behalf of the new lamps is that the initial investment per fixture complete is only about one-half that of flame arcs.

Electric Vehicle Convention

The fifth annual Convention of the Electric Vehicle Association of America will be held, in Philadelphia, October 19, 20, 21.

During the past year twelve sections have been added to the two existing at the time of the fourth annual convention held last year in Chicago, bringing the sectional representation up to fourteen, so that the reports of the various sections—distributed all over the country—will prove of unusual interest. Doubtless plans will be formulated at the convention which will enable the sections to make even greater advance during the coming year, and the reports and discussions of section activities should be one of the bright spots of the convention.

The following list of papers will be presented:—

"Progress of the Electric Vehicle," by James H. McGraw.

"Electric Vehicles in Parcel Post Service," by William P. Kennedy.

"Electric Vehicle Charging," by J. F. Lincoln.

"Special Applications of Electric Trucks," by F. Nelson Carle.

"Electric Vehicle Performance," by Robert B. Grove.

"Effects from the Utilization of the Kinetic Energy of an Electric Vehicle," by T. H. Schoepf.

"A Wider Dissemination of Electric Vehicle Information," by T. I. Jones.

"Calculations of Electric Motor Characteristics and Prediction of Vehicle Performance," by A. A. Nims.

"Educating the Public in the Field and Use of the Electric Vehicle," by F. C. Henderschott.

"Power Wagon Operation in Central Station Service," by W. A. Manwaring.

"Electric Fire Apparatus," by Chief George S. Walker.

"The Design and Performance of Electric Vehicle Motors," by H. S. Baldwin.

Symposium—"The Electric Industrial Truck," by manufacturers.

"The Cost of Electric Vehicles," by George H. Kelly.

"European Development of the Electric Vehicle Industry," by P. D. Wagoner.

"Constant Potential Systems for Charging from Motor Generators," by H. P. Dodge.

"The Motor Truck in Traffic Congestion," by Lieut. William D. Mills.

The Moloney Electric Company of Canada, Limited, have vacated the office they have been occupying in the C. P. R. Building and have taken new offices in the Traders Bank Building. The general sales office for Canada is now established at the above address.

The Illumination of a Modern Factory

Warrants Very Careful Consideration—Location of Equipment, Degree of Illumination for Various Purposes and Physical Effects are all Determining Factors

By Mr. F. R. Ewart

The illumination of a modern factory is a problem which warrants very careful consideration. It is no longer possible to ignore the fact that proper lighting has a very definite influence on the way in which work is turned out and this influence is a matter of dollars and cents to the manufacturer in the final analysis. The physical effect on the workers of eye strain due to glare, or of vitiation of the atmosphere from burning illuminants, will show up immediately in the quantity and quality of the work they turn out. The closely allied psychological effects of comfort or discomfort will naturally still further magnify these results. It is not possible within the scope of this article to consider these interesting matters in detail, but it is hoped that the suggestions may serve to emphasize the importance of the question.

The old method usually employed consisted merely of putting an outlet in each bay and experimenting afterwards to find some equipment that would give the required results. Unfortunately is is often found that many outlets are not in the right place and that units of the right size greatly overload the circuit. If the work is in conduit it will frequently be impossible to adapt the system satisfactorily. If, on the other hand, open wiring has been installed, it may be possible by considerable cutting and tapping to fit things up so that they "will do." In most cases the resulting arrangement is sloppy and often positively dangerous. The efficiency obtained by such methods, as judged by current consumption will rarely be up to the mark. The only proper way to get the best results is to consider the illumination scheme in detail at the beginning and then put in the wiring necessary to operate the installation.

Determination of Requirements

The first essential in the determination of requiremests is proper knowledge of the nature and disposition of the factory equipment. In some cases it may be sufficient to indicate roughly the conditions existing on each floor or portion thereof. As a rule, however, it is advisable to make complete lay-out plans of the whole factory. It is obvious that stock rooms and general open spaces will not require as high a degree of illumination as areas over which actual work is being done. Then, too, the requirements for different kinds of work will vary over quite a wide range. Operations on large objects conducted at a slow rate may be well served by a moderate lighting intensity, which would be quite inadequate for fine work put through rapidly. The contrast between a large boring mill and an ordinary sewing machine will serve to illustrate this point.

The degree of illumination required for various purposes is determined largely by experience, under the guidance of established data.

The next point for consideration is the question of interference from other equipment. Sprinkler systems, steam and water pipes, shafts, belts, etc., all have their place in a modern factory. It is only in minor details that these features can be made to show any consideration for the lighting equipment. To a very large extent the lighting will have to be arranged to look out for itself.

Lastly, thorough consideration must be given to the physical and psychological effects above mentioned. An installation which presents a dazzling glare in every direction may produce poorer results than the old-fashioned fire fly system of drop cords so familiar a few years ago. A system of large gas arcs may provide excellent lighting from a photometric standpoint, but when installed in a large factory with low ceilings and indifferent ventilation, they may play a large part in making the workers dull and drowsy in the middle of the afternoon.

Meeting Requirements

After the requirements have been carefully determined, it is not such a very difficult problem to fulfil them. It must be remembered that efficiency is the real determining factor. The question of aesthetics can not be considered to any serious extent. It is, therefore, a much simpler problem than store illumination, for instance, where the twin questions "What will it do?" and "How will it look?" are absolutely inseparable. In the case of the factory, it is only necessary to decide upon the easiest and most economical way of meeting the pre-determined conditions.

Fortunately we have available a very wide variety of equipment, so that it is hard to find a case which cannot be solved by some standard article on the market. Then, too, the choice already at hand is regularly being supplemented by new lines, thus making it continually easier and easier to find what is wanted.

It may not be out of place to say a few words in regard to proper illumination data. Most of the reliable manufacturers can furnish complete photometric curves of every variety of equipment they handle. In many cases these are thoroughly authenticated by the fact that they are prepared by independent laboratories of wide repute. Such information is absolutely essential to the illuminating engineer. He cannot afford to accept the bald statement that it is a first class reflector and has given good satisfaction in so-and-so's factory. He must know just how good and how he must handle it to get the best results. The best reflector in the world may prove worthless if improperly installed. Since he proposed not to guess at the question, but to work it out on a scientific basis, he must have full and accurate information on a product or he cannot use it.

In settling on the equipment to be used the question of location enters so intimately into the problem, that by the time a satisfactory solution has been obtained the matter of locations has been solved also. In some places they will be on quite short spacings. In others they will be separated by comparatively long distances. The exact location of many outlets may be partially affected by the consideration of other nearby equipment.

Having selected the units and located them, nothing more remains than the consideration of control. In many cases several units serving the same work may be required altogether or not at all. Under such circumstances these units are best grouped on a single switch. In other cases it may be necessary to control individually. With the control decided upon, it is a simple matter to group the units properly into circuits and thereafter complete the balance of the wiring system required to handle the complete installation.

Economics

With the system thus worked out down to its final details, it is in order to make a final survey from the economic standpoint. From this it must not be inferred that this all

important consideration has been put aside during the work of solving the problem as outlined above. It is an insistent dictator on every point that comes up. The final net results, however, can only be determined accurately after the other work has been completed.

The efficiency of the installation is first judged by the limitation of the total connected load within reasonable bounds. This may be expressed in terms of kw., per thousand square feet. But this figure may vary fairly widely depending on the average intensity of illumination that has been required. Then, if this quantity be divided again by the average intensity in foot candles obtained throughout the factory, the result, which may be expressed as kw. per ft. candle per M. sq. ft. will represent an absolute measure of the efficiency of the installation. This should come out at about 0.2 in a case where the efficiency question has not been over-ridden by other considerations.

From the efficiency determined in this way and the known cost of current, we may determine the operating cost for the whole factory and on a basis of cents per hour per ft. candle per M. sq. ft. Then a careful estimate of the value of the installation will give the capital cost, from which may be deduced the annual fixed charges in interest and depreciation. This last item will probably be determined more from the standpoint of obsolescence and length of tenure than on a basis of the full useful life of the equipment.

The third element of cost to be taken into consideration will be maintenance. In an installation of incandescent lighting, where the materials used throughout are of the best grade, maintenance should not amount to much more than the cost of lamp renewals alone. With a more elaborate equipment such as arc lamps, the maintenance problem may assume a more complicated aspect. The sum of the three items, current, fixed charges and maintenance, may be expressed in terms either of annual cost or total cost per ft. candle per hour per M. sq. ft. For example, with an efficiency of .2 kw. per ft. candle per M. sq. ft.; current at 3½ cents per kw.h.; an installation cost of $10 per outlet; allowing 6 per cent. interest and 10 per cent. depreciation; an average operation of 50 hours per month; and tungsten lamps at prevailing prices—the total cost per ft. candle per hour per M. sq. ft. would run about 1.5 cents. Since the fixed charges amount in this case to about one-third of the total, it will readily be seen that the amount of use will widely affect the net result. In any case the figures obtained by these methods will give a reliable means of judging the value of the work accomplished.

Elec'l Trade in Western Canada

By Mr. R. H. Mainer

I have heard it remarked during the last sixty days, "that the electrical business in the West was working overtime to keep alive."

The universal tightening of the money market during last winter, the "marking time" period in anticipation of a busy fall, and then the announcement of only a half crop,—capped by Canada going to war with Germany,—has certainly affected all kinds of business in Western Canada, the electrical as much, but probably not more than any other.

During the last five years a rapid growth of things electrical has taken place, so much so that manufacturers in Eastern Canada, the United States and even Europe have directed special efforts to participate. Encouragement has been given to firms and individuals to push for business in every way possible and numerous western commission agents, jobbers and salesment have sprung into prominence as a result. Everything favored individual effort, and excepting in the case of a limited number of firms of reasonably strong financial standing, considerable business has been carried on, mainly at the expense of the principals and not of the agent.

The last twelve months has steadily worn down the resources of this large but poorly equipped section of the business community, and as a result many names of individuals which have flourished for a time are rapidly disappearing and this is as it should be. Under the best of circumstances these trades would have failed in time, and whilst the sudden breaking down of a number seems to point to an unhealthy state, yet it is driving what good business there is still to be done into safer and more permanent quarters.

There is little complaining to be heard from the business houses of good financial standing, although it is true enough that they feel the loss of the booming western optimism which is so characteristic.

Retrenchment in expenses, curtailing in buying and a general tendency to cut off loose credit is being carried to the limit, and the effect has already steadied current business affairs until the element of doubt as to the future is practically eliminated. The old days when twenty-five salesmen would gather in a town of less than five thousand population, and with lavish expense money try to outdo each other in every manner of extravagance to win a prospective customer, have gone the way of the buffalo and the red man, and the trade in general heaves a sigh of relief and is glad.

Personally, I have had recent visits from representatives of United States firms, who come to this city two or three times each year, and they report the outward appearance of the city of Winnipeg, in so far as general business is concerned, as better than the cities to the South. We are turning out hundreds of men for active service in the present war, and yet all the stores appear fully manned and the boss goes about with a cheerful countenance that surely belies many tales of Western depression, which come in from the outside.

From all central western points the better class dealers are ordering, small orders, but often. Salesmen on the road report considerable building, which has been crawling slowly for some months, as being hurried to completion. It is not safe to forecast the future, not until the German war troubles have been wiped off the map, but for the few months remaining of this year the feeling is general that a fair average business will be transacted and, with the advance in all prices which has developed, probably more than average profits will be shown.

It never has paid to gamble on the credit in Western Canada and now it could not even be called a gamble, but a sure loss, and more than ever it will be a necessity for eastern and foreign producers of goods to depend on the representative and substantial jobbers and dealers now situated in the West, and who are specialists in the conditions existing. The small commission man, the itinerant peddler of a few lines, and the petty dealer in a small community must give place to the better equipped concerns, who spend good money from exacting shareholders to buy and warehouse stocks of goods to be served out at the discretion of a well organized credit department

The West, once a runway for all kinds of cheap material, most of it of foreign manufacture, has at last decided that products nearer home are better, and the cooperation of their places of supply more easily obtained when within a few days' journey, and more general good will doubtless be experienced.

Mutual patience and co-operation between East and West is the thing most needed at present, and those who realize this now will profit the most when trade resumes its normal position again.

Influence of "Glare" in Poor Illumination

A Condition Easy to Recognize but Difficult to Overcome—Causes Eye Strain and Defective Vision

By Mr. E. N. Hyde

Probably one of the most frequently used terms indicating a condition of bad illumination is the term "glare." There is no question in the mind of anyone that such a thing as glare exists, and that it is an evil greatly to be avoided. Probably the public suffers more from glare than from any other fault in installations of artificial lights. More harm probably is done to our eyes because of glare than any other one thing connected with artificial illumination. Millions of people are daily—or more appropriately, nightly—having their eyes subjected to strains, and their vision baffled by "glare," and it goes on week after week, month after month, and year after year without protest from the public, without restriction by the authorities, and without widely spread protestations from the oculist and medical fraternities who best of all know the havoc glare is doing in the way of damage to the visual organs of humanity.

Not infrequently some enterprising newspaper or periodical describes an aggressive business man's sign as being wonderfully bright and unique in design, but ignores altogether the unwholesome presence of glare that has been added to the altogether too many existing cases that literally shine, so conspicuous are they on the main thoroughfares of every large town and city of this Continent.

Glare, however, is an evil that also exists indoors, and the installation that totally eliminates its to be dreaded effects, is so rare that it is a matter that eloquently supports the claim that some concerted action on the part of educators, progressive central station men, boards of health and societies of medical and opthalmological graduates should be taken to promote good illumination. That no such action exists in Canada is discouraging, and displays the small success that has been attained by those, who, in an effort to improve artificial lighting and make it more healthful, have been trying for years to arouse the public to take active interest in the subject.

Glare may seem to one upon casual examination to be a simple phenomenon. A study of it, however, soon disabuses the mind of this mistake. It is like electricity, a something which exists with plenty of evidence of what it does, but cannot be put into exact terms, has no chemical formula to indicate its ingredients, and defies an exact pathological explanation for want of more information. It is physiological, and is without standard measurement. By altering conditions it can be made to exist or not to exist at will, without change in the artificial light, but by a change in the quantity of sunlight admitted to the eye, simultaneously with the artificial light. Sunlight itself can reach the eye, so as to produce glare, and the eye itself automatically protects itself within a wide range, against a condition of glare, often at the expense of good vision. Glare sometimes disappears when there is more light flux present than when a lesser amount in the shape of a beam is in range of vision. A few examples may serve to illustrate. A room may be well and comfortably lighted by a large window through which daylight pours. If a black opaque curtain be completely thrown over the window, so as to exclude all light, except that permitted to enter through a small hole in the curtain provided for the purpose, the beam shining through this hole will cause glare, if the eye is placed so as to intercept it, but this beam is no brighter than the light entering when the window was uncovered.

A yellow flame arc lamp hanging low in front of a moving picture theatre is an abominable source of glare at night, but when burning in full daylight looks low in luminosity, and the eye that was blinded by it at night feels no discomfort in broad daylight. The white looking nitrogen high efficiency incandescent lamp, rich in green and violet rays causes us to close our eyelids if we view it at night, but we would be likely to walk by the same lamp at noon hour without even noticing that it was glowing, if it happened to be burning at a street corner. If by chance we did observe it in full daylight, the filament is markedly yellow, by contrast.

These phenomena would suggest that the admixture of sunlight with artificial light is a cure of glare, yet the glare effect of looking at the sun is ruinous to the eye, and the glare of reflected sunlight from the snow is the cause of snow blindness. This leads us to study the affected member, and we find some very peculiar activities in the eye itself. It would be out of scope of this article to describe these peculiar happenings in the eye; they are complex and technical, demanding the treatment of the opthalmologist's pen, so I omit any reference to them, further than to say that a great deal has been written on the subject. Enough, we hope, has been given to indicate that glare is a complex problem, and has many sides to it. There are some interesting data, however, on ways of eliminating glare, and if put into practice, will help largely to improve conditions that should not obtain. First of all, some interesting experiments by A. J. Sweet, member of the firm of consulting engineers, Vaughn, Meyer & Sweet, Milwaukee, Wis., disclosed that if a light source is so placed that its rays do not fall on the eye at an angle of less than 25 degrees to the axis of vision, the ability of the eye to discern detail (visual acuity) is not impaired. So if lights in a room are placed high the eye can look at a picture placed on the wall considerably higher than the height of the observer without the detail being obscured. Poor vision of the picture results when a region of the retina is over stimulated as happens when the light sources are so low that an angle formed by a line from the pupil to them, and a line from the pupil to the centre of the top part of the frame of the picture, makes, as frequently happens, an angle at the eye of less than 25 degrees. The over stimulated region has superimposed upon it the image of the picture, and the discernment of the latter is reduced in clearness by the former.

Another condition of glare is avoided by using relatively dark wall paper for several feet above the floor. Lighter wall paper may be used to fill out to the ceiling, and the consequent reflection value of the lighter hues largely retained. The ceiling, of course, can be white, or very light in color, without in any way contributing to glare, especially if it be matted. The darker band or wainscoting absorbs the greater part of the light which would be reflected by a white or light surface directly into the eye, glare resulting whether the wall be matted or glossed.

Glare from polished desk tops of desks upon which a plate glass cover has been placed, contributes a frequently observed unhealthy condition, ignored by thousands every day. Depolishing the wood varnish or covering the glass with a large blotter pad disposes of much regular reflection from local lights while some forms of semi-indirect and total direct lighting will effect a cure if general lighting only is used.

There are thousands of factory operatives working in Canada with a lamp hung directly in range of vision, and they

look past them at their work. The factory manager, who will take time to record the improvement in output, will find the increase sufficient to pay well for any investment made to provide the proper opaque shades which will send more light to the work, and keep the glaring rays of his employees' eyes.

Electric signs using high candle power lamps are often installed right in line of vision, and as one walks down the street, the sign obscures by contrast everything else, even the shop window articles on display. Coloured caps over the lamps form a permanent cure and lend novelty in the possible combinations of hues in letters or designs. Flame arc lamps which now hang so that a passer-by is nearly blinded by their glare and blinks in distress as he goes by them, will be much more effective if a shade be placed so that the light shut out of the pedestrian's eyes is reflected instead to the building front, which consequently will stand out more conspicuously than ever. Street standards are all the better for being high, and the more diffusing the glass globes about the lamps, the more acceptable they are, and it will be found too that vision is better even if the diffusing glass-ware absorbs so much that the consequent lumens are very greatly reduced. Cornu tried to prepare a table showing, in logarithmic terms, the increase of light flux to the retina by variations in the diameter of the pupil due to the contraction of the iris. He was not entirely successful in that his table would not hold for individuals, the variations in the personal equations being too great. Since then it has been shown that sometimes we can see better by decreasing the light, as would be the case if a bare electric lamp were taken down, frosted by sandblasting until it absorbed 7 per cent., and was reinstalled. More light may enter the eye notwithstanding this 7 per cent. decrease, because the enlargement of the pupil permits enough light in addition to enter, to more than offset the effect of reducing the candle power of the lamp. If this happens, the pupilary increase in area has been greater than 7 per cent., while the light was diminished only 7 per cent. by the sandblasting.

Diffusion has much to do with the performance of the eye, the light source being changed from the relatively small area of the filament to the comparatively large area of the frosted lamp bulb. The same holds true for globes that surround street lights. Sweet ascertained that certain zones about a street light contributed more to glare than others, and he recommends that the zone made by the angle of 25 degrees below the horizontal plane passing through the source parallel to the street level should have in it something to suppress the radiations as much as possible, compatible with good appearance.

Research into the cause and effect of glare is going on, and is by no means nearing completion. Physicist and oculist alike are taking part in the work, but in the meantime citizens endure glare on the streets, workmen suffer from failing vision, school children wear glasses at astonishingly tender years, and bookkeepers and clerks go home with aching heads after working over pages of highly calendered paper all day.

Engineering Corps for the Front

The directors of the Canadian General Electric Company have raised a corps of engineers, numbering 25, who have already departed to take part in the new preparations going forward at Valcartier. According to official announcement, the company will also maintain this corps of engineers during operations. The following is the text of a brief address delivered by Mr.. Frederic Nicolls, president of the company, to this corps assembled at the head office of the company on the eve of their departure for the front.

"Captain Ritchie and men of the

Canadian General Electric Engineering Corps.

In times of danger to the Empire it behooves every corporation, as well as every private citizen, to render such service as opportunity offers, and I may say on behalf of our directors that after consultation with the government, part of the service rendered and to be rendered by our company has been to raise and maintain the corps of engineers to which you belong.

You have this morning been sworn in to serve your country as part of the permanent forces, and if appearance and past performance go for anything you can all be relied upon to serve your country faithfully, and cast no discredit upon the Canadian General Electric Company which is responsible for your efficiency.

Good bye and good luck go with you."

Counting from the left the names of the engineers shown in the photograph herewith are as follows:

Back row standing—1. H. S. Elliott, 2. Charles Stewart, 3. C. Pink, 4. W. J. Swanger, 5. F. G. Jackson, 6. H. Williams, 7. E. S. Shill.

Front row standing—1. Capt. Ritchie, 2. A. T. McLean, 3. W. S. Johnson, 4. J. S. Dunlop, 5. G. Hillier, 6. C. Henry, 7. George Monaghan, 8. A. Hardie. 9. J. C. Munro, 10. C. C. Rous.

Front row seated—1. P. Foster, 2. E. Crockford, 3. H. S. McKean, 4. A. J. Palmer, 5. R. W. Nurse, 6. H. Galvin, 7. R. Bethune, 8. H. Bestard.

Corps of Engineers despatched to Europe by Canadian General Electric Company.

New Street Lighting In Stratford, Ontario

Nitrogen Filled Tungsten Lamps Installed—A Handsome Pendent Fixture Mounted on Trolley or Separate Poles—Much of Work Underground

The Stratford Light, Heat & Power Commission have recently made a new addition to their street lighting system which has a number of features that are of considerable interest at this time.

The installation consists of 193 units located in the business district of the city. Without doubt it represents one of the most advanced types of street lighting on the continent and is moreover one of the first installations in which large units of nitrogen-filled tungsten lamps have been used. 500 watt, 6.6 amp. series nitrogen units have been used throughout. They are appropriately supported in a new type of pendent fixture mounted on brackets of serviceable and artistic design. The general style of brackets and fixtures is illustrated in Fig. 1 which shows the bracket mounted on steel railway poles. In certain localities there were no railway poles available and it was, therefore, necessary to install a standard for lighting purposes only. This standard is shown in Fig. 2 and consists of a neat cast iron column and base with a wrought iron crook to harmonize with the other brackets, mounted directly on the top of same.

Fig. 1—Brackets on railway jobs.

The pendent fixture consists essentially of a cast iron ventilated body having suitable ground and line insulation of porcelain, and supporting a Moonstone globe designed with very careful attention to correct illuminating properties. The globe is supported by means of a solid stamped steel ring giving a line contact and free from binding screws.

Fig. 3 is a view of the main street taken with the illumination from the new lighting at night.

The wiring of this system consists of three circuits run overhead from the main station and on the trolley poles, but where there are no trolley poles the connections to the cast iron standards are made underground with single conductor lead-covered paper cable laid in fibre conduit. The conduit is laid on a natural trench bottom and covered with 3-in. of concrete. The circuits are so laid out that two of them can be cut out at midnight and the all night service carried on one circuit.

The current is supplied from three constant current Adams Bagnall repulsion type transformers, two of which are 32 kw. capacity and one of 22 kw. Each transformer is controlled by a separate standard panel.

In the base of each standard is fitted a G. & W. combination absolute cutout and pothead. These devices are also fitted with a film cutout arranged to operate when the lamp is open circuited.

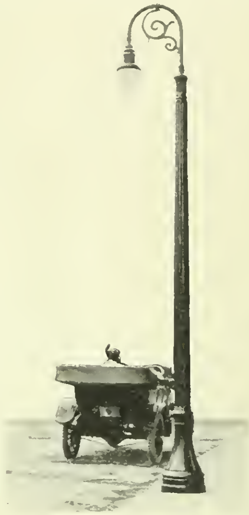


Fig. 2—Standard for lighting only.

The work was done in a remarkably expeditious manner, the first pole hole being dug on July 6th, and the installation completed in every respect before the end of the month.

Most of the equipment including the constant current transformers, panels, G. & W. combination potheads, cast iron standards and lighting fixtures were supplied by the firm of A. H. Winter Joyner, Limited.

Fig. 3—Stratford's Main Street.

A Year's Developments in Illumination

Comprehensive Review of the Phenomenal Progress of the Past Twelve Months Towards the Scientific and Economical Production of Good Light

The Illuminating Engineering Society of the United States each year appoints a committee on progress, one of whose duties it is to prepare for the annual convention a report of the developments in the various phases of illumination during the past twelve months. At the recent Cleveland convention a report of unusual interest was presented, extracts of which we are reproducing below. In introducing this report, the committee state that developments in the science of illumination and in the lighting industry have continued to an extent which proves that there has been no lessening of public interest and no cessation in the demand for improved lighting conditions. The "Safety First" slogan is reflected in the fulfilment of the requirements for safety lamps in mines. The detrimental effects of glare have been recognized and an effort has been made to avoid them in the headlights of automobiles. The very considerable increase in the intensities available in both gas and electric sources has made possible to a much greater extent than ever the use of diffusing globes and shades and stimulated the demand for artistic fixtures. The recognition of the scientific side of illumination has been growing and there seems to be more and more of a tendency on the part of those who control the lighting of buildings, stores, etc., both owners and architects, to take into account the principles which have been so faithfully promulgated by this society.

ELECTRIC INCANDESCENT LAMPS

Non-Vacuum High Efficiency Tungsten Lamps.—Last year's report contains a brief statement heralding the advent of the high efficiency tungsten lamp, and its introduction in a wide variety of sizes constitutes the most marked development in the sphere of the electric incandescent light. The use of the spirally wound filament in an atmosphere of neutral gas has made possible a higher temperature and a consequent considerable increase in light intensity, while at the same time bringing the source itself into such a relatively small space as to enhance its value when used in searchlights, in projection lanterns or with focussing reflectors.

At the time of the 1914 report of the Lamp Committee of the National Electric Light Association these lamps were available in the following sizes: for multiple burning on 100-130-volt-circuits 400, 500, 750 and 1,000 watts or in candle-power 535, 715, 1,250, 1,820; for series burning the number of units was larger ranging by moderate steps from 60 to 1,000 candle-power with a voltage range from approximately 6 to 55 and in amperes of 5.5, 6.6, 7.5 and 20. In England for the 100-130-volt range, lamps were announced of 400, 600, 1,000, 1,500, 2,000 and 3,000 mean hemispherical candle-power. At the same time announcement was made of series burning 50-65-volt lamps in 200, 400, 600 and 1,000 candle-power sizes, and of multiple burning on 200-260-volt circuits in 1,000, 1,500, 2,000 and 3,000 candle-power sizes. Subsequently this listing has been extended considerably. In this connection it should be noted that the changes in schedules of these new lamps have followed each other with such rapidity that before this report is published there will doubtless be available new limits of voltage and efficiency and new ranges of candle-power and watts.

In Germany the 50-volt, 110-volt and 220-volt types were advertised late in the fall. These lamps were tipless and contained nitrogen at an absolute pressure of about nine pounds per square inch (0.53 kg. per sq. cm.).

The new high efficiency lamp is being used in German theatres, and in this country in many places requiring very intense sources, such as display lighting and for the lighting of large areas. It is already a strong competitor of the ordinary arc lamps and the high power gas arcs. Efforts are being made to develop this lamp for use in moving picture machines where steadiness and high intensity are important.

Investigations of the properties of this new lamp have indicated a reduction factor in the neighborhood of 0.850, a temperature of approximately 2,600 deg. C. and a ratio of radiated energy to energy input of 60 per cent. as compared to 88 per cent. for the ordinary vacuum type tungsten lamp. A study of the energy distribution showed the wave length of maximum energy to lie close to 1.1 μ ($\mu = 0.001$ mm.) and the ratio of luminous to total energy radiated to be approximately 8 per cent. as compared to 4 per cent. for the ordinary vacuum lamp. The ratio of energy radiated in the visible part of the spectrum to the energy input was found to be approximately 5 per cent. as compared with 3.5 per cent.

Vacuum Tungsten Lamps.—Since the first of the year there has been a 10 per cent. increase in efficiency in the ordinary drawn-wire tungsten lamp both in the multiple type and also in the street railway and train lighting lamps and this has been accompanied by a decrease in price of from 10 per cent. to 15 per cent. There seems to be a steadily increasing tendency on the part of central stations to further the use of the tungsten lamp through free renewals and decreases in prices.

According to the Lamp Committee report the quality of vacuum tungsten lamps has been greatly improved. The filaments have been made stronger; a change has been made from heavy to light semi-flexible or flexible supports; and the introduction of chemicals to prevent blackening has been extended to the lower wattage and been greatly improved in the higher wattage sizes.

A decided improvement in these lamps has been along the lines of standardization and uniformity of the various constituent parts such as bulbs, stems, supports, etc.

Among foreign manufacturers a number of filament mountings have been worked out. One giving a maximum intensity in the lower hemisphere consists of a rectangular glass frame from which the supporting wires hang down, the filament being wound back and fort so as to lie in the same horizontal plane, the lamp being used pendant.

The ability to wind the drawn wire tungsten into spirals of very small diameter has made possible also a variety of methods of mounting. An arrangement giving a result similar to the one just mentioned consists in placing the supporting wires radially in the same horizontal plane and looping the filament between them. Another type uses three vertical glass rod supports with the filament wound spirally around them. Another has the supporting wires in the same plane and forming a four pointed star. In another lamp the filament is wound in the form of an inverted cone, and the bulb is either clear or has its upper half frosted and the lower half ribbed. One type uses the grid form first mentioned with the spirally wound filament. In still another type in order to get a maximum of length in a minimum of space vertically and thereby permit the use of a small diameter bulb, the spiral wound wire is held by supports which carry it spirally around the central glass supports.

This year has seen the almost complete elimination of

the tantalum lamp, the number used being less than 0.1 per cent. of the total number of lamps sold, while the number of carbon lamps used has dropped to only 10 per cent.

The government has revised its standard specifications for incandescent lamps. The new schedule calls for 200-260-volt tungsten lamps, raises efficiency limits and lowers voltage limits. The tantalum schedule has been dropped. In both the tungsten and graphitized carbon schedules the sizes of bulbs are named, indicating progress in standardizing which permits such designations.

An extension of that method of rating lamps for efficiency, based on the fact that equal efficiency means equal brightness in vacuum incandescent lamps having the same filament material, has been devised. The method is particularly designed for conditions where the testing voltages are fluctuating, and uses either direct or alternating current. The optical pyrometer principle is involved and the apparatus is very simple, including a voltmeter and some suitably chosen resistances.

The advent of the high efficiency non-vacuum lamp of high current has necessitated the development of special holders which shall provide ventilation and protection from moisture. In the case of the low-voltage high-current type a compensator for street series lamps has been produced which in some cases effects an appreciable saving in energy.

Various devices have been invented to prevent the unauthorized removal or theft of lamps and reflectors. One of these recently developed is so arranged that a lamp once screwed in cannot be removed without breaking it. Replacement of a lamp is accomplished by breaking the bulb, which allows the slipping off of the outer shell of the socket, and permits the unscrewing of the discarded base.

Difficulties in the manufacturing of carbon lamps in the early days are partly responsible for the wide range of voltages in the distributing systems of central stations. But the recent great improvement in the manufacturing processes connected with tungsten lamps has enabled the factory to produce lamps of a given desired voltage to within very narrow limits. It has been suggested that if it were feasible to have central stations adopt a standard voltage, it might be possible to still further reduce the price of lamps by relieving the manufacturer of the necessity of providing for more than one voltage.

Efforts are being made at the present time to have central stations bring their voltage as nearly as possible to the 120-volt centre.

ARC LAMPS

The result of considerable research has brought out an improved electrode for the magnetite arc. This, together with a prismatic refractor which redirects light formerly lost, has made a big advance in the mean hemispherical efficiency of this type of arc lamp.

Improvements have been made also in the flaming carbon arc lights. A new type has been developed in which the lamp forms the top of a pillar and which combines the operating characteristics of the long burning arc with the ornamental design inherent in the adoption of the classic column. Research has shown that good operating results may be secured by the use of a small condenser having vertical, concentric sides.

In response to the demand for ornamental units, the appearance and diffusion of arc lamp globes have received some attention with beneficial results.

In enclosed flaming arc lamps the effects of water in the enclosing globes has been studied recently. It was found that one effect is to lower the temperature of the arc due to the formation of hydrogen which rapidly conducts heat away from the electrodes. It was found also that there is a remarkable shortening in the life of the trim if moisture is present in the globe.

VAPOR AND VACUUM TUBE LAMPS

Mercury-vapor lamps in general, function on direct current. Those designed for and used on alternating current are arranged so that the final result is an unindirectional action. A new type of quartz mercury arc has been devised having only two electrodes, between which the current alternates. This is made possible at ordinary frequencies (50 volts) by using voltages not less than 600; a pressure not less than of the order of 1 cm. of mercury; the presence of self-induction in the circuit; and when starting having the electrodes already hot. A lamp of this type has been designed for 1,000 volts at the terminals, 1,000 watts consumption, a power factor of 0.7 and a candle-power of approximately 5,000 giving a candles per watt factor of 5.

Another new arrangement of the quartz mercury arc has for its object the production of a light source comparable in intensity with the carbon arc but with the objectionable heating removed. This is accomplished by making the lamp in the form of an inverted U and placing it in a flask one of whose walls is in the form of a paroboloid which may be silvered, and thus concentrate the light emitted through the opposite wall. The flask is made of pure transparent quartz and uses electrodes of invar metal. The whole is then immersed in a vessel either of glass or with glass sides, filled with water. One of the sides may be made in the form of a condensing lens. A lamp so constructed used 18 amperes with 70 volts at the terminals and was claimed to give 3,000 candle-power or about 0.42 w.p.c. Such a source would have its principal application in cinematography or photomicography.

In cases where the tilting method of starting mercury-vapor lamps is not feasible, a new starting arrangement has been devised, which uses a small auxiliary vessel containing a reentrant portion in which a heating coil may be placed without disturbing the vacuum. This small vessel is placed immediately below a part of the tube which is near the negative electrode and constricted. Initially the positive and negative electrodes are connected by a thread of mercury which is broken by a bubble of vapor arising and being caught in the restricted portion when the heating coil is started. The operation may be made quite automatic.

Neon.—Work is still being done on the study of the properties of the neon lamp. It has been found that, the current being kept constant, the drop in potential along the tube is approximately inversely proportional to the diameter, the tube operating under a pressure of about 2 mm. of mercury and a current density of 6 amperes per square decimeter. The effect upon the luminous power of varying the diameter has also been studied and it has been found that the luminous power increases approximately as the first power of the diameter. Owing to the loss of power at the electrodes, however, tubes of a diameter about 1 to 3 cm. are best if efficiency is to be considered.

In England the neon tube has been put on the market for advertising purposes in a standard length of 6 m. a diameter of 50 mm., and using 1 ampere with 1,000 volts at the electrodes.

Cathode Lamp.—A new vacuum lamp has made its appearance based on the fact that the cathode in a vacuum tube becomes very hot on the passing of a discharge. The inventor utilizes this phenomenon to bring to a glow a peice of Nernst heater used as a cathode and contained in a quartz tube, sealed by means of magnesia and pipe clay into a spherical glass bulb.

The claim is made that with 820 volts and 0.11 ampere, or 90 watts, the lamp burns as brightly as a 50 candle-power lamp. Further study is to be made on this lamp.

Ultra-violet Sources.—For some time quartz mercury-

vapor lamps, heavily loaded, have furnished the only intense source of ultra-violet radiation in practice. A method has been recently devised which considerably increases the effectiveness of such lamps by using a magnetic field and water cooling. This has the effect of reducing the density and consequent absorption of the vapor envelope, and shifts to the side of the tube the concentrated beam of light which ordinarily occupies the centre of the tube.

Deduced from photographic action the improved lamp shows the greatest intensity in the region $\lambda = 0.254\ \mu$. A further interesting result is that using this lamp to excite a "resonance" mercury-vapor lamp (a quartz glass absorption vessel provided with a drop of mercury, exhausted and sealed) the extremely monochromatic radiation of wavelength $\lambda = 0.2536\ \mu$ may be produced continuously and with considerable intensity.

A study of the oscillating spark between various metal electrodes as a source of ultra-violet radiation has shown a maximum intensity when using invar, the value being almost twice that obtained with copper.

LIGHT SOURCES FOR PROJECTING PURPOSES

Headlights—The enormous increase in the use of automobiles both for pleasure and traffic has made the question of proper headlights of steadily increasing importance. In the larger cities particularly legislation to prevent the use of dazzling headlights has been put into effect. One result has been the development of numerous schemes to shut off the excess of light while in the city, but leave the full intensity available for use on unlighted roads.

Instead of using four headlights, two of high power for country touring and two of low power for city driving, one arrangement provides twelve lights placed along the filler board between the wind-shield and the top of the engine hood. When not in use the lamps are completely covered by a sliding shutter which may be moved to permit the use of as many as desired and of particular ones if necessary. Furthermore the angle of the group of lamps can be varied at the will of the driver, so as to illuminate any portion of the road, or the engine of the machine.

In another system, two lamps are used, having a tubular body, fitted with a system of lenses and a reflecting mirror, the result being a concentrated beam projected in nearly parallel rays, and capable of easy direction.

Another form has two pairs of translucent wings mounted on pivots and made to open and close by electromagnets controlled by a push button on the dash.

The National Physical Laboratory has had the subject under advisement for some time and recommends the cutting off of the light beams coming from the upper right hand corners. The right hand corner is indicated because in England the rule of the road is to the left.

In regard to locomotive headlights a similar state of interest is evident, but the crying need for definite information as to the actual needs in this direction is evidenced by the fact that in this country twenty-eight states have adopted legislation embodying seventeen different specific laws governing the use of such headlights.

Searchlights.—A big advance in searchlight construction is shown in a new type which has small electrodes, operates at a high current density and temperature and has an improved specific consumption. The current density is about six times that of earlier types of lamps. This is accomplished by forcing alcohol vapor around the electrodes to act as a cooling medium and protect the electrodes from too rapid combustion.

The positive crater appears like a sharply defined point of light of extremely high specific intensity. The feeding of the alcohol vapor takes place automatically when the arc is struck, a valve governed electromagnetically being used for this purpose. Both electrodes are rotated uniformly in order to maintain perfectly uniform bathing of gas, and are placed the one horizontal, the other at a certain angle to insure equal combustion.

Signal Lights.—A striking departure from former methods of railway signalling is forecasted in the results of tests made to determine the right intensity of a signal lamp so that it will be clearly visible in bright sunlight and not too dazzling at night. If practical experience proves the system to be as effective as the preliminary tests indicate, the old semaphore arm method of daylight signalling will become obsolete in cases such as electric roads where energy is cheap.

The method of momentarily obtaining high intensity by using a tungsten lamp at voltages much above normal has been utilized in a signalling device for soldiers and airmen. It consists merely of a minute incandescent lamp in conjunction with a parabolic mirror and arranged so that the circuit can be closed intermittently to give long or short flashes, corresponding to the dots and dashes of the Morse code.

Another advance in the use of lamps for signalling is in connection with city traffic. A scheme is being tried out in Cleveland of directing traffic at busy street intersections by red and green lamps placed on cross arms on 15-ft. (4.57 m.) poles at each of the four corners. Control is vested in the traffic policeman who is in a booth at one of the corners.

An improvement on the reflecting portion of the light source of light-houses uses a mirror composed of elements both parabolic and annular combined with a spherical mirror. The former project the rays emitted from the front of the lamp, and the latter those from the rear.

MINER'S LAMPS

The past year has seen a remarkable development in safety lamps for use in mines. Over a year ago in a competition held in England 195 different portable lamps were submitted and of these a number were accepted. Recently the British Home Office has approved of several new types.

As the result of a prize competition in Germany, a lamp has been evolved which is not only safe if broken but is also claimed to give indication of the presence of fire-damp. The principle on which the indicator is constructed is based upon the law of diffusive action. The indicator consists of a U tube containing a colored signalling fluid and so disposed that the presence of gas causes an obscuration of the light.

However, objections have been raised to this form of indicator based on the fact that it would not be operated upon by an explosive gas mixture, if this mixture were of the same density as the air.

In this country developments have proceeded along two lines, lamps designed for mines where fire-damp or other explosive gases are encountered, and those designed for mines such as metal ore mines where these difficulties are not encountered. Three out of six lamps sent to the Bureau of Mines for test were accepted for use in gaseous localities. These were of both the hand and cap service type. The following specifications have been issued by the Bureau:

Intensity of light at all times	0.4 cp.
Flux of light at all times	
Hand lamps	3 lumens
Cap lamps	1.5 lumens
Time of burning per charge	12 hours
Average life of bulb	300 hours
(Not more than 5 per cent. to have less than 250 hours.)	
Average life of batteries	3,600 hours
Variation in energy consumption of bulbs ...	10 per cent.
Angle of reflector	100 degrees

STREET LIGHTING

The constant demand for better public lighting is reflected in the increase in installations in some of the large cities of the country, during the past year. The luminous arc was being installed in large numbers up to the time of the introduction of the non-vacuum high efficiency tungsten lamp. There is already considerable evidence that the latter will be used in many places to replace the former.

EXTERIOR ILLUMINATION

The satisfactory results obtained in the artificial lighting of tennis courts has caused a considerable extension of this form of lighting. In England, covered tennis and squash courts have been artificially lighted, both with high pressure gas units and electric lamps.

The value of light seems to be more and more appreciated in every walk of life. An experiment in the use of artificial light to increase the output of a poultry farm has resulted in a reported increase of 30 to 40 per cent. in the number of eggs laid. In the case of young incubated chicks, the use of light made them feed longer and thereby accelerated their growth during the winter months by a third.

The growth of aeronauties has created the need of properly illuminated fields for rising and descending at night, and various suggestions have been made and experiments tried to determine the most suitable method. A need has also arisen for illuminated signals and signs so that an aeronaut travelling at night may determine his location and avoid dangers in descending. In the case of signal lights on the machine themselves, it is evident that arrangements must be made to indicate not only the direction of travel in a single plane but also whether a rise or drop is contemplated.

It is interesting to note that the Port of London Authority has recently equipped the dock policemen with electric torches to take the place of the old fashioned oil lanterns.

The logical development of the animated sign has made its appearance in the use of moving vehicles carrying highly illuminated displays.

The lighting of Christmas trees in the home is a custom almost if not quite as old as the use of the tree itself. A recent innovation adopted by many American cities at the last holiday season consisted of out-door "community" trees, in all of which illumination was a conspicuous feature of the ornamentation.

In regard to display lighting in general there has been a decided increase in the number of buildings lighted on the exterior for display purposes. In the past there have been numerous cases of so-called "outline" lighting, in which the lights showed the contours. A new method called "flood" lighting is being introduced in which the exterior of the building is brilliantly illuminated by sources placed at a distance.

The use of high towers for street illumination purposes was discontinued some years ago. The system has been revived recently for use in lighting railroad yards. Steel towers 100 ft. high and 12 ft. square at the base have been placed at 500 ft. intervals and equipped with quartz mercury-vapor arc lamps.

INTERIOR ILLUMINATION

Car Lighting.—Interest in improving the lighting of railway coaches and street cars continues and is apparently growing. Indirect and semi-direct methods are being studied. In one city twenty street cars have been equipped with three different semi-indirect systems in order to see which appeals most strongly to the public. There is a general recognition that bare lamps are bad and that it is well worth while to use reflectors.

The final report of the Committee on Illumination of the Association of Railway Electrical Engineers contains among other conclusions that equally satisfactory results may be obtained with either the centre deck or half deck arrangement of the lighting units; best results will be obtained with a spacing not greater than two seats apart. The elaborateness of the tests and the expense involved are a most gratifying tribute to the importance attached to better lighting in trains.

Store Lighting.—That the educational efforts of this society are continuing to bear fruit is indicated in the lighting installation of a large department store. In this case the window lighting system was worked out with foot lamps and border lamps equipped with movable color screens, so that the quality of the light could be altered to suit the requirements. The main lighting, of the semi-indirect type, has also a modified color value. For the trying on of theatrical costumes, the foot lamps and border lamps are not only provided with means for color modification, but also with dimmers and a spot light is likewise available.

In order to eliminate the annoying reflections from the glass of show windows, a new system has been devised in which the window pane is made concave inward.

Another novel application of the indirect lighting system has been made in the case of banks where the lamps are contained in troughs along the bank rail over the teller's desks.

School Lighting.—During the course of an extended discussion before the British Illuminating Engineering Society on the subject of daylight illumination in schools, it was brought out that as a minimum actual illumination on the desk for reading in the school room in full (midday) daylight, different authorities recommend from approximately 1 to 8 foot-candles. Among the new suggestions were, the determination of the "sill-ratio," i.e., the ratio between the illumination on the window sill of the school room and that on the desk most remote from the window, as a means of determining the access of daylight into schools; experiments to ascertain how far it is possible by using small models to predict the actual daylight conditions in an interior; and an "indicator-photometer" as a means of signalling when the artificial light should be turned on.

In a later interim report the following tentative suggestions were made:

> No place is fit for use as a schoolroom when "diamond type" cannot be read easily by a normal observer at a distance of half a meter.
>
> The darkest desk in any schoolroom should receive an illumination equivalent to that derived directly from 50 reduced square degrees of visible sky. In these circumstances the place should receive not less than 0.5 per cent. of the unrestricted illumination from the complete sky hemisphere.
>
> The windows should be located in the wall to the left of the pupils, and the glass should be carried to the ceiling and not interrupted by cornices, pillars, or decorations.
>
> No desk in a schoolroom should be farther from the window wall than twice the height of the top of the glass above the desk surface.
>
> The ceiling should be white. The wall opposite to the window and the wall behind the children should be lightly colored from 30 in. (0.76 m.) above the desk level. The wall around or behind blackboards should be somewhat darker than the rest of the room.
>
> All furniture, desks, and surfaces in the lower part of the room should be finished in an unobstrusive color, dark shades and black being avoided.

It should be noted that there are some points in these suggestions on which more definite information is desirable,

and further work on the subject will doubtless meet this need.

Church Lighting.—There is a growing tendency away from the old belief that the interior of a church should be in a state of twilight illumination, toward a realization that the church should be made cheerful and that this is to be accomplished by good lighting. For this purpose the indirect lighting method is growing in favor although the lower installation and operating costs, as well as the architects' influence, are responsible for the use of direct lighting in some cases even in new churches.

Picture Lighting.—The proper lighting of pictures has been a vexing problem with illuminating engineers for many years. While it is comparatively easy to see what is required for a single picture, to produce the result not only for one, but many has taxed the resources of numerous engineers and architects. At a recent Art Loan Exhibition an effort was made to illuminate the pictures as far as possible by light coming from the right direction and also of the proper color content. Plain and colored lamps were used, placed in troughs above and in front of the frames and so arranged that no light was specularly reflected to the eye of the observer.

GLOBES, REFLECTORS AND FIXTURES

Since the last report there has been a great increase in the variety of reflecting and diffusing equipment available for lighting. This increase has proceeded along artistic lines, along engineering lines, along the lines of special adaptation to particular needs, along the lines of higher and lower priced units and of larger and smaller units.

This increase in variety is particularly noticeable in the semi-indirect field. In selecting units to-day, the selection can be made from a much greater choice than was possible a year ago. There is also a tendency on the part of manufacturers to put out units which approach direct lighting in the results they give, as far as diffusion is concerned, but have the appearance of a semi-indirect lighting unit. This has resulted in the closing of the gap between direct lighting and semi-indirect lighting, as far as reflecting and diffusing equipment is ocncerned. This emphasizes the need of some other terms than indirect and semi-indirect to apply to lighting systems.

There is a greater tendency in the design of globes and reflectors to have them particularly adapted to architectural needs and particular classes of service. There is a greater variety of units corresponding to particular periods of architecture, and units designed especially for the lighting of churches, hospitals and residences are more in evidence.

From an engineering standpoint the most marked developments during the past year are those involving the use of semi-indirect fixtures for both gas and electric lights and in particular those which have accompanied the advent of the high candle-power and high efficiency gas cluster lamps and the non-vacuum tungsten lamps. The high intensity of these types has made the need for the use of diffusing globes more apparent than ever. In all the units put out for these lamps and the holding equipment for them, the ventilation is an important feature and in the case of gas lamps mica sheets are utilized to baffle the heated products horizontally and thereby prevent ceiling discoloration. Mica baffles are also used in gas lamps below the source to prevent over heating of the glassware. Another point of interest in the tungsten lamp is that the type of filament is much more concentrated than formerly and this is a distinct advantage in that it is possible to obtain higher efficiencies and better distributions of light than were formerly possible with much longer filaments.

In industrial lighting there has been a noticeable tendency in the direction of the increased use of deep bowl reflectors. In street lighting a prismatic refractor has been developed which gives a very extreme distribution of light, the candle-power being highest at about 75 to 80 deg. from the vertically downward direction.

The extent to which the artistic in lamp fixtures has progressed is shown in the production of a dome made of china by a manufacturer of artware and dinner sets.

Mention was made in last year's report of the use of marble in thin sheets to replace glass in lamp fixtures. A big improvement in this material is shown in the production of plates ⅛ in. to 4/5 in. thick (3 to 20 mm.) polished on both surfaces and impregnated with various oils at high pressure and temperatures. In this connection a recent investigation of this material has shown that it is much more translucent than milk glass. The treated marble was found to transmit more red and much more blue than milk glass and is a good diffusing agent even though having a translucency of 40 per cent. The following table shows the results found on the translucency and diathermacy of these marble sheets as compared with various substances.

Translucency and Diathermacy of Various Substances

Thickness and material of interposed stratum	Percentage of light transmitted	Percentage of heat transmitted
None	100	100
Treated marble 0.12 in. (3 mm.) ...	41	5.1
Untreated marble 0.12 in.	21	4.9
Mica 0.02 in.	33	67.5
Clear glass 0.08 in. (2.2 mm.) ...	92	80.0
Hard rubber 0.01 in (0.3 m.) ...		51.7
Writing paper	27.5	4.8
Writing paper oiled	55	16.7
Milk glass 0.12 in.	25	16.6
Ground glass 0.12 in.	76	40.6

A still further extension of the daylight duplication idea is to be found in the development of spectacles made of colored absorbing glass fitted with a dyed film. Different spectacles are designed for different light sources, the materials used being the same as those which would be required in order to make an artificial daylight lamp out of the source in question.

Fixtures have also been designed which give a light distribution in a room similar to that given by a window, thus imitating daylight distribution.

The importance of avoiding glare is being appreciated to such an extent that spectacles using colored glass have been devised for attachment to the visor of a base ball player's cap. They are instantaneously adjustable and should be of considerable help to the player when it is found necessary to look directly toward the sun.

Trade Enquiries

Name and address of inquirer may be obtained on application to the Electrical News, Toronto.

920. **Electrical machinery, all kinds.**—A South African firm of electrical engineers makes inquiry for catalogues with f.o.b. prices on Canadian-made electrical machinery of all kinds.

The Gananoque Electric Light & Water Supply Company, Limited, have submitted to the corporation of the city of Kingston a proposition for the supply of approximately 700 h.p. of electrical energy at the rate of ¾c per kw.h. The proposition deals with other matters also, such as obtaining from the corporation the right of way over certain streets, etc. The entire matter has been submitted to the city solicitor and Mr. C. C. Folger, general manager of the light, heat, power and water department.

Typical Residence Lighting Specifications

A Detailed Scheme for the Illumination of the Average Sized Home

By Mr. S. G. Hibben, Illuminating Engineer

In the Electrical News of September 1st was given a typical set of wiring plans and specifications covering the electrical equipment of a residence of average size, including all necessary details from the main switch and fuse box up to and including the point of providing the lighting fixture outlets, switches, outlets for portable cooking, heating or lighting accessories, as well as a discussion of the factors governing the choice and location of such outlets.

We here present a similar outline, beginning with the

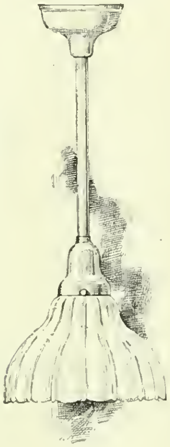


Fig. 1.

outlets as previously located, and detailing the types of lighting fixtures, with lamps and glassware, that would be necessary in securing the complete lighting installation.

As stated in connection with the wiring plans, it is hardly to be expected that these suggestions will coincide with the individual tastes or requirements of every house builder. They are intended to illustrate the method of procedure and to show how advantageous it is to have a comprehensive out-

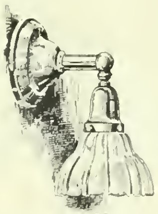


Fig. 2.

line of the lighting fixture equipment in an accessible form. The choice of the lighting fixtures has herein been based on engineering considerations, keeping always in mind the artistic side of the question as well. Without lengthy and tiresome discussion it would be impossible to give all the reasons for the selection of various fixtures. These selections are based on items of efficient control of light, avoidance of glare, the right amount of light, the most harmonious and decorative units, moderate expense and permanency.

The same set of plans is used in this connection as were previously printed as forming a part of the wiring specifications.

General Specifications

The following general specifications, in conjunction with the tabulated details and plans that accompany and form a

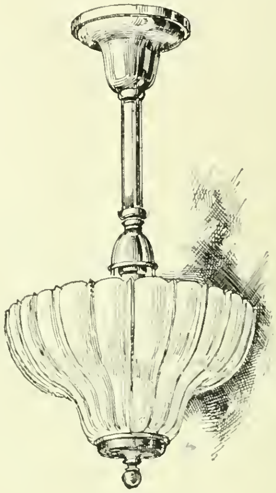


Fig. 3.

part of this report (see page 54) cover the location of lighting fixtures, the style and finish of same, the glassware equipment, the hanging heights, the proper lamp sizes, and the general results secured.

Outlets

The outlets are used as shown on the accompanying

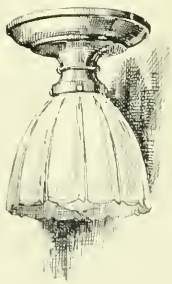
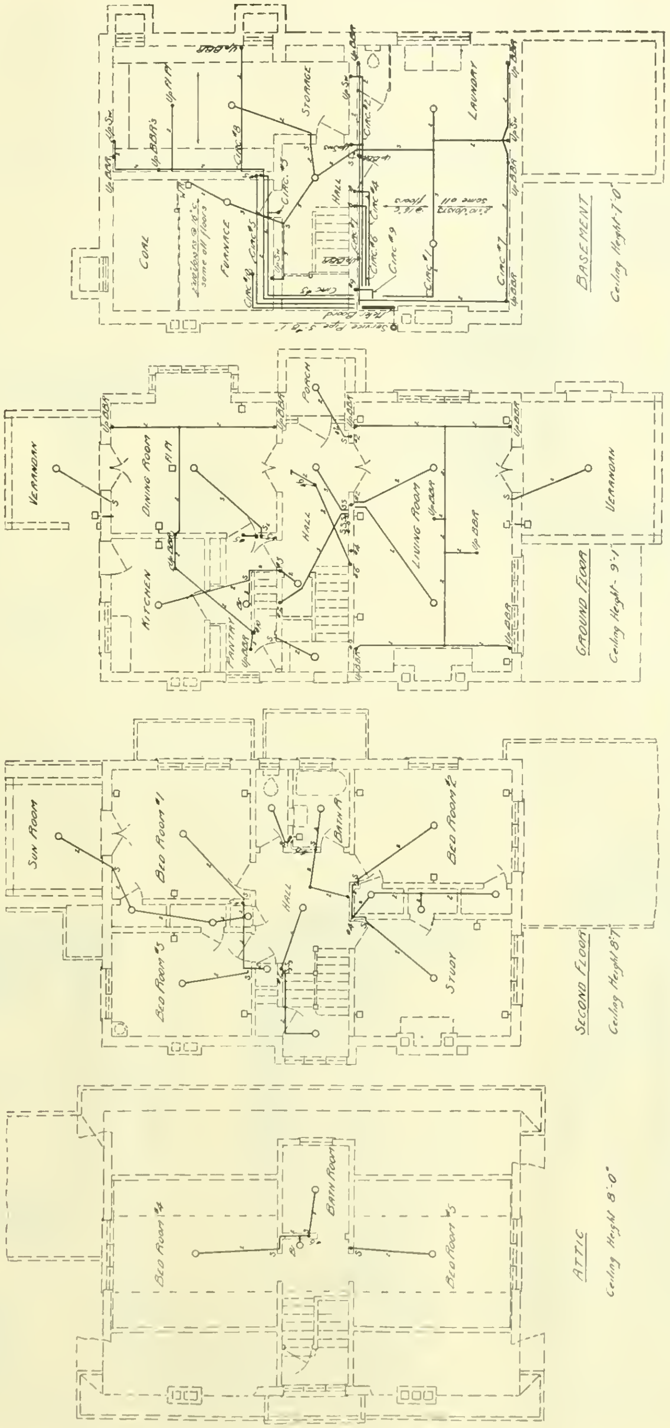


Fig. 4.

plans, such positions being in general satisfactory for the correct distribution of light. Any radical changes in outlets, caused by changes in the wiring on account of furniture, etc., should be given additional consideration inasmuch as the



Model diagram, for illumination purposes, of a typical residence of average dimensions—Also see specifications, p. 54.

specified fixtures are selected for exact individual service only in the places where specified.

No details are herein given for portable electric apparatus such as table lamps, electric irons, radiator stoves, etc., for which baseboard, floor or wall outlets have been provided.

Fixtures

All fixtures are to be provided wired complete ready to hang, but without lamps.

Finishes of metal parts are to be as specified in the de-

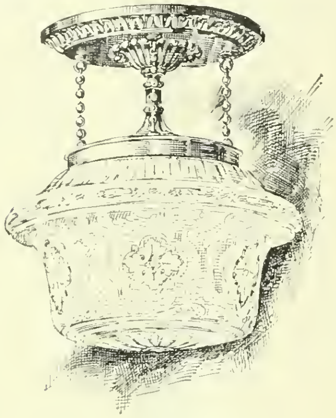


Fig. 5.

tailed scheme, such finishes to harmonize with the other interior hardware.

Metal parts of all fixtures to be of standard and approved gauge if spun, or of clean chaste detail if cast. No stampings are to be used.

All proper glassware holders are to be furnished as a part of fixtures. No changes in glassware or in lamp sizes are to be made without corresponding changes in holders.

Fixtures designated as "receptacles" to consist of porcelain base receptacles of approved make. All such recep-

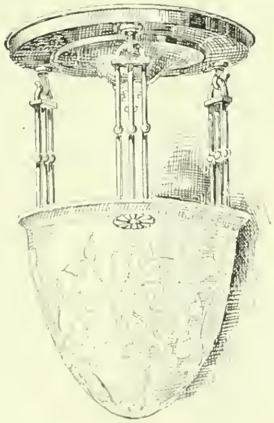


Fig. 6.

Fig. 8.

tacles in closets are to be provided with pull-chain control. All such receptacles for items 22 and 23 to be provided with Form "O"-2¼-in. holders. No holders are to be furnished for other receptacles.

Lamps

No lamps are to be provided on this schedule. However, the sizes as specified should be carefully adhered to in purchasing, in order to insure the correct relation between the lamps and their reflectors or globes. Lamps should be clear, bowl (or end) frosted, or full-frosted as specified, and should be chosen to burn at their top voltage as marked on the lamp label.

Glassware

All glassware is to be used as detailed, since any changes will jeopardize the efficiency and harmony of the system.

Illustrations of all recommended glassware appear together with the illustrations of fixtures that accompany and form a part of this report.

Illumination Results

In general the illumination will be found satisfactory for all ordinary conditions. The results will depend considerably upon the colors of interior finishes. In the bed rooms, baths,

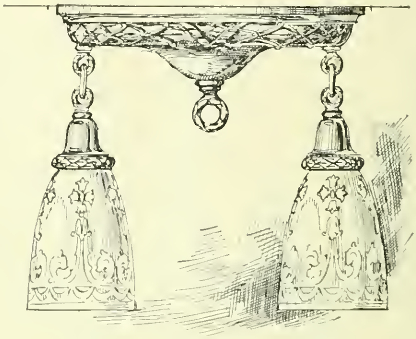


Fig. 7.

sun room, halls and closets the interiors should be light, as gray, cream, light tan, light pink, etc. In dining and living rooms and study the finishes may be slightly darker, as shades of green or gold, old ivory, etc.

Under the above conditions the illumination over the useful portions of the several rooms (at table height) will be about as follows:—

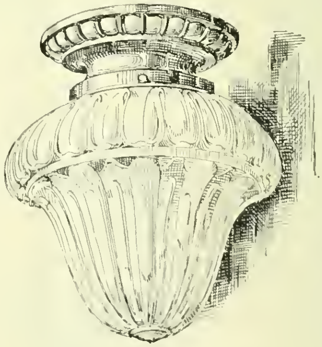


Fig. 9.

Bed Room No. 1	2.5	Foot-candles
Hall	2.0	" "
Kitchen	4.0	" "
Living Room	2.5	" "
Dining Room	6.0	" "
Veranda	0.7	" "

In commenting upon the detailed specifications, the following points might be mentioned:

Attic

1. The pendent fixture in the bath room is especially suitable, on account of its simplicity and its sanitary features. A 60 watt lamp may replace the 40 watt lamp here if considerable use will be made of this room. The distribution of light is fairly extensive.

2. Bed rooms 4 and 5 will be evenly and softly illuminated by the simple semi-indirect units, making brackets unnecessary for local lighting. The chosen type of fixture is inexpensive, yet efficient.

Second Floor

1. In the toilet the most simple type of ceiling fixture is satisfactory in holding an intensive form of reflector, to direct most light downward over a small area.

2. The fixture for bedroom No. 1 will be particularly decorative in a room finished in rose, cream or blue colors. It employs a softly diffusing globe, etched and decorated in mauve and lavender or gray and blue tints.

The 100 watt rather than the 60 watt sizes of lamps are used here and in bed room No. 2, since no wall brackets are to be used.

3. Bed room No. 2 has a fixture with diffusing bowl having a little warmth in colors of green and pink. The lamp in this bowl should not be placed too low, in order to secure the best results from ceiling reflection.

4. The study being most probably furnished on the order of a den, would be properly equipped with the verde antique fixture No. 19832, and amber tinted glassware giving most emphasis in illumination directly beneath the fixture. A portable lamp will be used here for reading.

First Floor

1. Efficiency is the keynote of the lighting fixture in the kitchen. Considerable illumination is provided for here. Glassware is used that may be easily cleaned.

2. When using the semi-indirect unit over the dining room table, it will be found to brightly illuminate the table top, and the rest of the room less so. Three lamps in the bowl are to be arranged on one circuit, and one lamp on the other, thus allowing dim, medium or bright lighting.

3. The living room fixtures are primarily to be for decoration as well as utility, since a portable table reading lamp will no doubt be used.

Basement

1. Efficiency and economy are considered above all else in the lighting of the baesment rooms. Reflectors in the laundry are more broadly extensive than in other rooms.

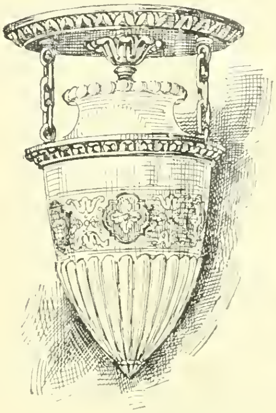


Fig. 13.

Fig. 14.

Illuminating Engineering Society

The General Convention Committee of the Illuminating Engineering Society have published, in advance of the Convention, very interesting and complete details of the proceedings and have distributed widely an attractive souvenir programme. An interesting feature of this programme is a brief synopsis of each paper which gives, in a few lines, the scope of the matter to be covered in each case. The booklet also contains the entertainment programme of the entire week, together with considerable other information about the convention.

Fig. 10.

Fig. 11.

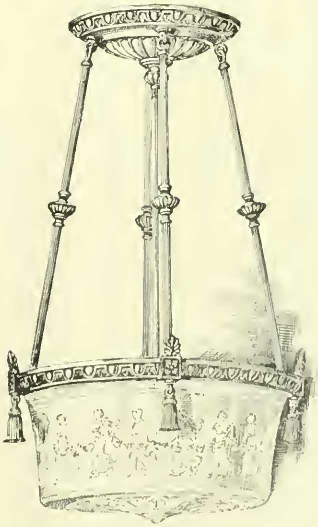


Fig. 12

Detailed Specifications for Model House

Item	Space to be illuminated	No. of outlets	General type of fixture	Fixture No.	Finish	Fixture height	Class and type of glassware	Size of lamps (Tungstens except where noted)	Illus. No.
	ATTIC								
1	Bath	1	1-E Pendant	40912	W E	1' 6"	Alba Shade 3424	40 W Bowl Frost	Fig. 1
2	Hall	1	1-E Bracket	70012	B B	5' 3"	Alba Shade 3419	25 W Bowl Frost	Fig. 2
3	Bed Rooms 4 & 5	2	1-E Semi-Ind.	50100	B B	1' 8"	Alba Shade 3446	100 W Clear	Fig. 3
	SECOND FLOOR								
4	Bath	1	1 E Pendant	40912	W E	1' 9"	Alba Shade 3424	60 W Bowl Frost	Fig. 1
5	Toilet	1	1 E Ceil. Fixt.	31002	B B	On Ceil.	Alba Shade 3417	25 W Bowl Frost	Fig. 4
6	Bed Room No. 1	1	1 E Fixture	48717	B B B	1' 4"	Decora Globe 3660 E-159	100 W Clear	Fig. 5
7	Bed Room No. 2	1	1-E Fixture	55980	B B	1' 6"	Decora Bowl 1605 R-3	100 W Clear	Fig. 6
8	Bed Room No. 3	1	2-E Fixture	23722	B B	1' 6"	Decora Shade 1601 E-103	40 W Clear	Fig. 7
9	Study	1	3-E Fixture	19832	V	1' 6"	Iridile Shade 2649	40 W Clear	
10	Sun Room	1	1-E Ceil. Fixt.	33004	V	On Ceil.	Alba Globe 3773	60 W Clear	Fig. 8
11	Hall	1	1 E Ceil. Fixt.	33016	B B	On Ceil.	Alba Globe 3658	60 W Clear	Fig. 9
12	Stair Landing	1	1-E Ceil. Fixt.	33004	B B	On Ceil.	Alba Globe 3656	25 W Clear	
13	All Closets	7	1 E Recept.	.....	......	On Ceil.	No Glassware	25 W Full Frost	
	FIRST FLOOR								
14	Kitchen	1	1-E Cord Drop	41000	......	1' 6"	Alba Shade 3429	100 W Bowl Frost	Fig. 10
15	Dining Room	1	4 E Semi-Ind.	51399	S B	2' 2"	Alba Bowl 3649	3-40 W Clear 1-25 W Clear	Fig. 11 Fig. 11
16	Living Room	2	1-E Semi-Ind.	55318	B B B	2' 4"	Decora Bowl 3746 E 152	100 W Clear	Fig. 12
17	Hall	1	1-E Fixture	48707	B B B	1' 4"	Alba Urn 3652 E-149	60 W Clear	Fig. 13
18	Pantry	1	1-E Bracket	70012	B B	5' 3"	Alba Shade 3419	25 W Bowl Frost	Fig. 2
19	Large Veranda	1	1-E Ceil. Fixt.	31004	V	On Ceil.	Alba Ball 2688	40 W Clear	Fig. 14
20	Porch & Small "	2	1-E Ceil. Fixt.	31003	V	On Ceil.	Alba Ball 2687	25 W Clear	
21	Closets (2)	2	1 E Recepts.	.....	......	On Ceil.	No Glassware	25 W Full Frost	
	BASEMENT								
22	Laundry	2	1-E Ceil. Recpt.	.....	......	On Ceil.	Alba Shade 3432	60 W Bowl Frost	
23	Hall	1	1-E Ceil. Recpt.	.....	......	On Ceil.	Alba Shade 3424	40 W Bowl Frost	
24	Storage	1	1-E Ceil. Recpt.	.....	......	On Ceil.	No Glassware	40 W Clear	
25	Furnace Room	1	1-E Ceil. Recpt.	.....	......	On Ceil.	No Glassware.	60 W Clear	

Effect of Consumers' Apparatus and Wiring on Distribution

By H. Goodwin

It is a comparatively simple matter to lay out a system of wiring a building, distribution lines and station apparatus which will give perfect service for any given combination of loads, but the duties of a distribution engineer are to make the best use of the lines available for supplying any proposed load without involving such cost as to make the proposition prohibitive from a commercial standpoint or without putting the consumer to such great expense for interior wiring as to make the service undesirable from his point of view.

When public electric service was first started it was for lighting purposes only. The service was generally only half night service; interruptions were frequent and voltage regulation was comparatively poor.

Conditions have changed and continuous good service has become in many cases a necessity.

Motor Service

The use of current for lighting was soon followed by the use of current for motors. These motors were at first small, and on account of the general irregularity of service no great trouble was caused by them. The power business has since become very important. The multitude of uses for small motors has also contributed very largely to obtaining many consumers for lighting. Since the introduction of electric current for power and lighting have gone hand in hand, it is natural that often a single service has been run for supplying both the light and the power and the consumers' wiring has been simplified as much as possible by the combination of lighting and power loads without regard to interference with service to one by the other.

Since motors cannot be started without a greater demand from the lines than is necessary to run them after starting, various well known devices have been introduced to minimize the starting current.

Many electric power companies employ polyphase generation and both polyphase and single-phase distribution, the latter for lighting and small motors. In such cases it is necessary (in fairness to motor users as a whole and to the company) to have some fixed rule as to size of motor above which no single-phase service will be rendered and below which no polyphase service will be rendered. This size varies from 1 h.p. to 7.5 h.p. with different companies, depending upon local conditions.

The polyphase motor means a lower initial and a lower maintenance cost for the user; and for the power company it means lower and better balanced starting currents and less interference with lighting service of other customers, but on the other hand polyphase motors mean greater line and transformer expense (except in large sizes) and greater metering expense. Such a rule as to maximum size of single-phase and minimum size of polyphase when once established in a community should be strictly adhered to in order to save money both for the company and for the small polyphase motor user when he moves from one street to another.

In order to cut down the starting current the general practice is to require auto starters on single-phase motors from two h.p. up and on polyphase motors of five h.p. and up.

In the report of the Electrical Bureau of the city of Philadelphia, just issued, the following appears:—

"The time required in repairing troubles on the underground system has been very much reduced by the use of an electric truck, the number of hours in which the underground circuits were out of service having been cut down in 1913 about forty per cent. as compared with 1912.

"The cost of operation in 1913 was a little less than for 1912 even with the greater amount of work.

"The forces employed were twenty as compared with twenty-one in 1912."

At the annual meeting of the Dorchester Electric Company, held at Quebec on September 8, the following were elected directors: Hon. Nemese Garneau, Messrs. C. H. Branchaud, Joseph Gosselin, G. E. Tanguay, G. Proteau, Milton L. Hersey, A. E. Doucet, Ferdinand Roy and H. A. Cook. Messrs. Milton L. Hersey and H. A. Cook replace Messrs. J. Robinson and W. T. Wilson.

Good Lighting vs Highest Efficiency

Proper Illumination a Paying Investment—Better Work and More Work—Discussion of the Main Factors to be Considered in Industrial Lighting

Good lighting bears a well-defined relation to the amount and quality of the factory product. If the lighting is poor, the shop is not operating at its highest efficiency. Time is consumed in carrying over the tool or the work or both to a place where the light is good, or time is lost in moving the light, or inferior work is done in a poor light. The demand for better illumination is of course greater during the winter months. Not only is this urgent on account of increased quality and quantity of product, but the number of accidents resulting from improper lighting have been shown to be very considerable. Indeed statistics compiled in a number of industrial plants at different seasons of the year show that, as the number of daylight working hours diminishes, the number of accidents increases in nearly the same proportion. It has also been shown, however, that this increase in the number of accidents can be wiped out under conditions of correct illumination. Under the conditions of our Workman's Compensation Act, the elimination of accidents will be a very prime consideration, and no factory manager will be well-advised who does not see to it that his illumination is of the best.

The cost of a correct lighting system is considerably less than is generally supposed, and is negligible when compared with an operator's wage. In support of this statement we submit the following analysis:—

A 100 watt lamp, lighting 100 sq. ft., is assumed for each man; and that it burns 2 hours a day for 300 days.

Cost of lamp ($150 contract; 17 per cent. discount)		$0.67
Average cost of bowl shaped enamelled steel reflector		.95
Estimated cost of wiring per outlet		4.00
Total first cost		$5.62
Interest on investment 6 per cent.	$0.34	
Depreciation on reflector and wiring 0.12½ per cent.	.62	$0.96
Power at 5c.		3.00
Cleaning at 3c. per cleaning, two per month		.72
Renewal of lamp $\frac{600}{1000} \times 0.67$		.40
Total		$5.08

Wages for 10 hours a day, 300 days, at 35c per hour are $1,000.

Ratio of cost of lighting per man, to wages $= \frac{5.08}{1000} =$ 0.508 per cent.

The above figures show, that one-half of one per cent. of a man's wages is sufficient to provide him with adequate illumination. In other words, with the conditions outlined above, if improved illumination saves the operator three minutes during the day, the light has more than paid for itself. This says nothing of added safety to the operator or improved quality of the workmanship.

In industrial lighting problems there are three main factors which need consideration:

1. The average intensity of illumination required on the working plane.
2. A convenient size and spacing of the lighting units to give a reasonably uniform illumination on the plane.
3. The watts per square foot necessary to give the required intensity of illumination.

These three main factors must be considered individually and collectively, and their solution must depend to a large extent on the past experience of the illuminating engineer.

The average intensity of illumination required on the working plane has been time and again tabulated for almost every variety of building and process of manufacture. These tables, which vary considerably according to the source from which they spring, should act as a guide in making up illumination specifications. Conditions vary so greatly that every case requires individual attention, and no hard and fast rules can be laid down for intensity of illumination required.

The intensity of illumination required depends not only

on the character of the work carried on, but also on the color of the materials worked with; the color of the background those materials are viewed against, and more particularly, the contrast between these two.

A man threading a needle requires good illumination, but while this illumination may be 1,000 ft. candles, and the needle be held against a steel grey background, it will be a difficult matter to thread same. However, if the illumination is reduced to ½ ft. candles, and white background employed, the needle can be threaded with ease. This is an experiment which can be easily tried, and is most convincing. Thus, it would seem that it is possible to imagine different conditions under which 1,000 ft. candles is insufficient, and ½ ft. candle is more than sufficient for comfortable seeing.

Machine parts and commercial materials generally are dark in color, and consequently it is an enormous help to comfortable seeing if all backgrounds, whether walls, ceilings, pillars, and in some cases even parts of floors, be light in color, preferably white or light yellow.

Not only are light walls and ceilings of value in giving contrast, but more important still, they reflect an enormous amount of light which would be otherwise lost, and thus serve as a secondary light source of large area, and low intensity, which produces a minimum strain on the eyes.

In many buildings of the older type of construction,

where the windows are comparatively small, this light reflection is necessary to assist daylight illumination.

To fix any definite illumination intensity, therefore, it is necessary that a thorough knowledge of the buildings be at hand. It is an easy matter, if expense be disregarded, to lay out a lighting scheme which will give more than sufficient light, but what the factory manager wants, and what he asks the illuminating engineer to design, is a lighting scheme which will give everywhere sufficient light and no more: sufficient light being usually defined as that amount which will enable an employee to work quickly and accurately without eyestrain, and further will allow employees to see their way about the shop and around moving machinery without liability to accident. The problem of the illuminating engineer is to make interest on first cost, plus cost of upkeep, plus cost of power, a minimum.

The necessity of getting as much light as possible on the working plane together with the essential necessity of keeping rays from sources of high intrinsic brilliancy from striking the eye, have proved beyond any doubt the economy and advisability of using reflectors with all lamps, and globe

diffusers with many. The shape of these reflectors, and the position of the lamp in them, are chosen with a view to screening the filament of the lamp and reflecting light in such a direction as to increase the uniformity of illumination on the working plane, or to localize it on a particular object. The cost of upkeep will be kept at a minimum by using tungsten lamps with reflectors that are easily cleaned.

Having selected a convenient lamp size, and chosen a suitable reflector, the candle power curve of this unit should be used to obtain the illumination given by it at various points on the working plane. Taking four such units and imagining them placed at the four corners of a rectangle of dimensions equal to the lamp spacing, a curve can be plotted which will show the variation of illumination along the plane between the units.

When such curves have been drawn for a large number of cases an accurate estimate of the average intensity of illumination can be made by the illuminating engineer, starting with watts per square foot, and knowing the lighting units to be employed, and the character of the building to be lighted. This is one of the problems of the illuminating engineer in making industrial lighting specifications; viz., a quick interpolation for given conditions between watts per square foot and average illumination; intensity on the working plane.

Having determined the watts per square foot necessary, the engineer knows the transformer capacity of the installation. He next proceeds to locate the most advantageous centres of distribution for panel boards, and draws out plans for the wiring of the units to these panels, and the wiring of the distributing panels to a main switchboard.

In making up lighting specifications, as few different sizes of lamps as possible should be employed, as this simplifies replacement and storage of renewals.

Electrical Illumination for Portraiture

An announcement of interest is to the effect that there is being manufactured in Canada a system of electric lighting for photograph studios, called the Viceroy system, for securing photographic results hitherto not obtainable with any other system of lighting. This system has been in use for some time by photographers in England, and at the recent Photographic Arts and Crafts Exhibition held in London, after very exhaustive tests, it was stated that no daylight studio could hope to compete with this new form of artificial lighting.

The source of light is a series of lamps of special design, the rays emitted being rich in ultra-violet light—one cause of the speed obtainable in the exposure. The regulation is automatic, the lamps requiring no attention whatever while in use. It is claimed that there are no flickers and that the whole studio is flooded with a smooth, even lighting, free from glare.

The lamps are small in size, which admits of their being placed close to the ceiling of any fair sized room. The lamp installation is supported by a light framework attached to the ceiling. This leaves the entire floor of the studio clear, so that the patient or camera can be placed anywhere. It is claimed that this lighting is obtainable with a certainty and rapidity which is a revelation to those accustomed to the tedious adjustments of blinds, screens and reflectors.

One important result claimed for this system is that negatives are obtained in which the harsh shadows under the eyes

Portrait Illumination.

and nostrils, folds in the flesh, wrinkles, etc., are rounded off, thus dispensing with the work of retouching. At the same time the character of the face is preserved without any exaggeration of the features. It is claimed for the system that it practically abolishes the need of retouching.

The intensity of the light reduces the length of time of the exposures to a minimum. With a rapid portrait plate one-quarter of a second only is required, with a lens portrait of f/8, for children in light costumes, and one second for heads and busts. With lens at f/4 or f/3, exposures are 4 or 6 times shorter. Thus fully exposed negatives are obtained with shutter exposures. The accompanying illustration is a typical studio with the Viceroy system of illumination installed.

In addition to the 4 ampere and 6.6 ampere pendent type luminous arc lamp, of which there are many thousands in use throughout this country, the Canadian General Electric Company are placing on the market a new pendent unit, known as the Form 8. This unit is similar to the 4 ampere Form 3, except that it takes a different magnetite electrode, which has a life of 350 hours, thus requiring to be trimmed only twelve times per year. This puts the luminous arc lamp, which is a very high efficiency unit, in a class by itself so far as trimming is concerned. New high efficiency electrodes will soon be available for all forms of C. G. E. luminous arc lamps. By the use of these electrodes the efficiency will be improved from twenty to forty per cent., depending on the form of unit, the efficiency in some units being as low as .31 watts per mean hemispherical candle power.

150,000-Volt Transmission System

Some Operating Conditions of the Big Creek Development of the Pacific Light & Power Corporation

By Edward Woodbury*

The most striking feature of the Big Creek development and transmission is the magnitude of the figures in which the plant data are expressed. In daily operation, 60,000 kw. are generated, utilizing a total hydraulic head of 4,000 ft. in two steps, and transmitted 240 miles at 150,000 volts, thus entailing some conditions of operation which are rather striking.

The transmission line is of course the element of greatest importance in satisfactory commercial operation, although there are many features of engineering interest in the generating and receiving parts of the system.

The most critical problem to be solved proved to be that of regulation. It must be remembered that the inherent regulation of the line alone, without terminal equipment, is from 10 per cent. above power house voltage at no load, to 20 per cent. below at full load; that the effect of the transformer inductive reactance at the generating end practically doubles the boosting at light load, and that the self-exciting characteristics of the generators, when supplying charging current only, tend to produce abnormal voltages at light load.

The complete success of the constant potential or zero regulation system, i.e., operation at the same voltage at the generating and receiving stations, is of particular interest. This result is obtained by the use of synchronous condensers at the receiving end, in conjunction with automatic voltage regulators, one for each condenser as well as for the generators at each of the power houses. Since there are two 15,000 kv.a. condensers and four 17,500 kv.a. generators to be controlled, the regulator problem received most serious consideration, and was made the subject of careful experiment under working conditions before being proved satisfactory, as it now is. It has been found necessary to arrange the regulators to control field currents from a maximum to zero.

In one generating station the excitation system consists of three direct-current units, one of which is the exciter proper, the other two being connected in series opposition, and used to excite the field of the main exciter, Fig. 1. The two units making up the secondary exciter are designed to generate 125 volts and 275 volts respectively. With a potential regulator on the 275-volt unit, arranged with auxiliaries to prevent a reversal of the field in the 125-volt unit of this set, the voltage applied to the exciter field may be changed from that required to give maximum excitation to zero excitation, within a range of voltage on the 275-volt unit, which can be readily handled by the standard alternating-current automatic voltage regulator.

The alternators at the other generator station are excited directly by 200 kw., 250 volt exciters, the main field of which is controlled by a new type of alternating-current automatic voltage regulator, which has no direct-current magnet and which can therefore be adjusted to reduce the exciter voltage to zero. The exciters on this system have three shunt windings on the field, as shown in Fig. 2. One auxiliary field is provided to give the reversed excitation necessary to hold the voltage down when charging the line, the current being supplied to this field, through a variable resistance, by means of a storage battery. The other auxiliary field, which is solely for the purpose of maintaining the correct polarity, also takes its current, which is small, from the same storage battery.

A reduction of the excitation to zero by means of the potential regulator, has not been necessary at the generating stations, but operation of the synchronous condensers at the receiving station, over the range required, would not be feasible without a complete reduction of the exciter voltage.

With 150,000 volts at the receiving end of the line, the charging current is about 40 per cent. overload for one generator. With normal voltage of 6,600 volts at the generator, the charging current overloads the generator 65 to 70 per cent. Hence in normal operation a line is usually energized by using two generators, under which condition a small field excitation in the normal direction is required. Abnormal conditions sometimes make it necessary to charge the line from a single generator, until the condensers at the receiving station can be started.

The self-exciting characteristics of the system with leading current are such that in one of the generating stations a

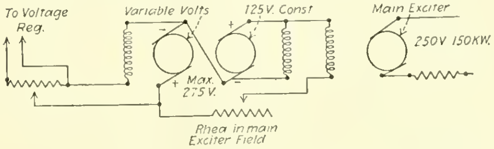


Fig. 1.

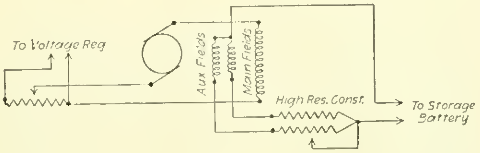


Fig. 2.

single 6,600 volt generator, when connected to an unloaded line without its condenser and run at normal speed with the field switch open, would excite itself to 7,000 volts, corresponding to 176,000 volts on the transmission line at the generating station, and demand from the generators 34,000 kv.a. and 850 actual kilowatts.

At the other station, where the generators were designed by a different manufacturer and had slightly different characteristics, the results were greater and the self-excitation under similar conditions would reach 9,000 volts at the generator or 230,000 volts on the line at the generating end. For this condition the generator would have to deliver 5,000 kw. and about 50,000 kv.a.

Means had therefore to be furnished for using current in a reverse direction in the generator fields to counteract the excitation due to the leading current.

The speed regulation by the waterwheel governor has been excellent, so that no complications have arisen from this source.

As might be expected with a system of this magnitude, special consideration has been given to minimizing the effects

*Read before the A.I.E.E.

of short circuits. Accordingly, the reactance of the generators of the two manufacturers has been made 70 per cent. and 85 per cent. respectively; of generating station transformers 5 per cent. and 8.5 per cent.; of receiving station transformers 5 per cent. and 8.5 per cent. The result is that the instantaneous short-circuit current is only 330 per cent. of full load on the generators and the sustained short-circuit current 110 per cent. with normal excitation of full load. Under these conditions the waterwheel governors shut off water on short circuit before any serious change in speed can take place.

On account of the use of aluminum cable for the transmission line, it is very desirable to suppress an arc on the line before the wire can be seriously injured; and there is now under consideration the installation of a field-killing relay to be installed in the neutral of the generating station transformers, which will very quickly extinguish the arc and automatically permit the restoration of voltage immediately.

Of the short circuits which have occurred, none have been sufficiently serious to burn down the cable. Some of the outer strands have been scorched, but not sufficiently so to diminish strength. The scorched sections are of course removed at the earliest opportunity.

The causes of the short circuits, which have occurred, may be stated as follows:

1. In the rush of construction, a tree was left standing too close to the line and blew against it. The cable was scorched, but not seriously hurt. This occurred during the tryout period, and while the voltage was returned to normal in a fraction of a minute, the load was transferred to the steam plant, for some time, while experimenting was done to endeavor to locate the trouble.

2. An irrigator tried to clean out a well near the line with a heavy charge of dynamite, blowing a lot of mud and water into the line. The current arced to the ground cable, but did not seriously injure the transmission cable.

3. One of the insulators on a disconnecting switch in one of the stations flashed over.

4. Seven other line short circuits have occurred, five of which have been found to be due to flash-over of insulators, one to be due to an arc from line to a tree during high wind, and the location and cause of the other has not been discovered. In every case of the above, trouble was cleared by reducing the voltage at generators upon current being observed in the ground ammeters, after which service was immediately resumed.

In all cases of insulator flash-overs, the damage to insulators was so slight that service could be resumed, without repairs, immediately on extinguishing the arc. In two cases, two disks out of the string of nine were broken down or badly shattered. In the third case, two of the disks were slightly chipped on the edge.

In the remaining two cases the arcing bars with which the insulator hardware is furnished protected the insulators against any damage. It is found that a flash-over will sometimes burn from one to two inches off the end of the arcing bar, and apparently does not go to the cable unless the direction and strength of the wind are such as to carry the arc out along the cable. The separation of the arcing bars is 51 in., equivalent to a break-down potential of over 500,000 volts at normal frequency.

5. The most serious line interruption was caused by a mechanical defect in a dead-end clamp at the end of a 2,700 ft. span, across a wide and deep river. The weight and tension of the cable make a repair of this kind a serious matter. The clamp which failed was one out of 5,000, so the percentage is not high.

The Illumination of Festival Hall at the Panama-Pacific International Exposition

Great advancement in the science of artificial lighting has been made by the department of illumination of the Panama-Pacific Exposition in planning an extensive and practical system of indirect lighting to meet the various requirements and physical conditions in grounds and buildings. The scheme adopted for illuminating Festival Hall is a unique method of flood lighting by indirect application. Much of the experimental engineering essential to working out this scheme of illumination was along the lines of pure pioneering in the science of electric lighting. Indirect lighting is occupying attention and testing the skill of electrical engineers the world over, and the advancement shown by the Panama-Pacific Exposition will be an interesting and valuable contribution to electric lighting practice.

The lighting of the various exposition buildings has presented numerous and devious problems and many and unique devices have been employed to illuminate effectively and yet in a manner that will command most favorable attention. To develop a subdued light that will be restful to the eye and still of sufficient strength and effective in all essentials, has been a most difficult task. This has been accomplished in the design adopted for lighting Festival Hall, to a degree surprising even to engineers of long practice. The scheme required special planning in the details.

Festival Hall has a seating capacity of 3,000, to be used for festivals and concerts, and will be almost continuously occupied during the exposition. The architecture is of French theatre design. The auditorium is covered by an immense dome.

A pit, 21 feet square and 12 feet deep, has been constructed under the centre of the auditorium floor. In this pit there are installed ten 18-inch searchlights of enormous power. It would have been relatively simple to arrange the searchlights had there been no obstructions, but the presence of a brick subway essential to the building, situated in the centre of the pit, made it necessary to arrange mirrors to redirect the light from six of the searchlights by reflection into a diffusing disc. The mirrors are placed on either side near the top on the brick subway at an angle necessary to secure the proper reflection. The four other searchlights are so situated that they throw their rays direct into the disc.

The diffusing disc is formed of plate glass, one-quarter inch thick and sand-blasted on the under side. The plate of glass is set in a circular aperture six feet in diameter, forming a collar to the pit. The rays of light from the searchlights are collected in this disc and indirectly diffused through the auditorium. The dome being painted a light color, acts as a reflector, and thus aids effectively in diffusing the light. That is, while the whole interior will be thoroughly lighted, it will be no more evident to the person sitting adjacent, as to the source of illumination than to a person at a distance, unless one is looking downward into the disc. The disc is surrounded by a parapet wall about four feet high and it is so set in the aperture that light will be directed from its surface to every portion of the dome. Conical mirrors are also set around and above the disc to catch any stray rays of light. By using colored screens over the lenses of the searchlights vari-colored lighting effects may be easily secured.

Each of the searchlights is of 6,000,000 candle-power. An enormous amount of heat is necessarily generated and a blast of cold air from the generating system will circulate throughout the pit, passing out above. A stream of water constantly running over the lens of each of the searchlights aids in the cooling. The diffusing disc will be cooled sufficiently by air circulation.

While the lighting of the auditorium is entirely taken

care of by this method, yet suspended fixtures are used in some of the alcoves. The balconies and foyer are lighted by such fixtures.

The footlights on the stage consist of 210 clear lamps and 70 each of amber, blue and red, with a 100-step dimming attachment. A complete portable system is provided by sixteen 300-watt stage pockets. The conference rooms and offices are lighted by small semi-direct units made from staff.

Relief lighting for the cupola above the main dome is accomplished by installing 250-watt units on each storey, placed one foot above the floor. The relief lighting for the pavilion towers has eight 250-watt units placed in the upper portion of each.

The total connected load exclusive of motors amounts to 106 kilowatts.

The construction of an auditorium along conventional lines, lighted by ordinary electrical methods with conventional fixtures and appliances, would have been a comparatively easy task from an engineering viewpoint. Visitors would have been impressed merely with the vastness of the undertaking in accord with the colossal scale of all the architectural construction of the exposition. But originality has been the keynote of the Panama-Pacific Exposition. The engineers selected for the illuminating department, as in other departments, were chosen for their ability to design and construct things new and apart from ordinary standards. The development of new standards in electrical engineering and construction, as in other efforts, for the benefit of present and future builders has been the aim and will prove to be the success of the exposition management.

To have illuminated so great an area on ordinary lines, would require a large number of lights, either suspended or fixed, occupying a considerable portion of space and furnishing imperfect illumination in many details. To make it possible to secure an entirely unobstructed view of the interior of the auditorium from any position, to be able to look upon the magnificent dome of Festival Hall uninterrupted by any disfigurements, is a notable achievement. This has been accomplished, and the visitors to Festival Hall, attracted by the various entertainments, will find that the added attraction of this new, novel and altogether unique method of illumination will make this grand auditorium one of the wonders of the great exposition.

One-Man Prepayment Bus Line

The Birmingham Realty Company, of Birmingham, Ala., a few months ago purchased four 15-ft. 6-in. omnibus bodies from The J. G. Brill Company as a means of increasing the transportation facilities to their Norwood property, a highly developed residential section situated about three and one-quarter miles from the centre of the city. During the short period the buses have been in operation, they have given complete satisfaction to the company and have become very popular with patrons on account of affording quick, clean and noiseless transportation; the route traversed is over asphalt streets.

The operation of the buses is on the one-man prepayment method. The door opening is enclosed by two manually operated double-leaf folding doors, which close in conjunction with a single folding step. In addition to operating the doors, the driver also attends to the collection of fares, with the aid of a fare-box located beside his seat, as shown in the above illustration. The roof is the standard plain-arch type, and is equipped with two ventilators, one at each end, located in the top panel. There are also two windows in the front end, the one directly in front of the driver being provided with a stationary weather shield. The sashes throughout are of the two-part type, the upper being stationary and the lower arranged to raise. The interior is finished in ash, natural finish, with bronze metal trimmings; the ceiling has a carline finish with roof boards showing. Transverse seats, three on each side, are of the stationary back type with 33¼-in. cushions; there is a single seat against the driver's partition, and a full-width seat at the rear end; all these seats are upholstered in twill-woven rattan, and provide a seating capacity of 18, which is the number for this size and weight of body. The driver's seat is upohlstered in leather. The two-ton Pierce-Arrow chassis has a wheel base of 15 ft., and the wheels are 36 ins. in diameter. The body weighs 2,600 lbs., and the chassis 5,600 lbs.

The underframe is of Brill standard construction and built entirely of ash. The side sills are 2¼ by 4 in.; the built end sill 1¾ by 4 in.; the rear end sill 1¾ by 5½ in.; there are three crossings 1⅜ by 3 in., and four 1⅜ by 1¾ in.; the latter attached to 3-in. channels form furring to which the floor boards are attached.

The corner and side posts in the upper framing are also of ash, 3½ by 1½ in., respectively. The entire construction and equipment are modern, and the buses present an excellent appearance.

Some Newly Worded Warnings

From the time you start to leave the car till you reach the sidewalk never stop looking for danger.

Don't hesitate in front of a car, it confuses the motorman. Go forward or back in a decided manner.

When you stop to think be sure to stop in a safe place.

Get in and out of a car quickly, but don't hurry—hurrying is dangerous and sometimes fatal.

Don't let a child under eight cross a trolley car street alone.

If you don't warn and take care, your child may be maimed or killed, no matter how much we warn and take care.

Double your watchfulness when you cross a double-track street.

Personal

Mr. R. D. S. Beckstedt has been appointed superintendent of the Tagona Water and Light Company, Sault Ste. Marie, succeeding Mr. R. A. Campbell.

Mr. J. C. Ross has succeeded Mr. Henry Dodue as chief engineer of the Yarmouth Light & Power Company, of Yarmouth, N.S.

Mr. F. W. Moneur, sales manager of the Canadian Tungsten Lamp Company, Limited, of Hamilton, Ont., has resigned his position, effective October 1st.

Mr. H. W. Scott, manager of the Montreal office of the Jeffrey Manufacturing Company, has resigned to establish himself in the engineering and contracting business.

Mr. M. W. Sherwood, assistant sales manager for many years at the Columbus, Ohio, factory of the Jeffrey Manufacturing Company, has been placed in charge of their Montreal office.

Mr. Wm. Somers, formerly electrical inspector for Petrolea has been appointed to a similar office in Chatham. Mr. Somers will also have charge of suburban towns located within easy travelling distance of Chatham, such as Wallaceburg and Dresden.

Mr. John Hare, superintendent of the Barrie Municipal Electric System, met with a serious accident recently. The Barrie power supply enters the Barrie sub-station, from Severn River, at 25,000 volts, and it was this line Mr. Hare came in contact with. After a few days' forced rest, we understand he is back on the job, a somewhat scarred but wiser superintendent.

The Dealer and Contractor

Valuable Suggestions for Getting and Carrying Out a Wiring Contract

In this article the fundamental idea is to outline what to the writer would appear to be a proper manner of working up a prospective job, of laying it out, of preparing the estimate, and finally after receiving the contract, of doing the work, sending in the bill and collecting the money. In other words, a complete wiring transaction from the time the customer makes his first inquiry to the time the transaction has been carried through and completed.

The house owner has for some time been impressed with the desirability of electric service for his home, and has finally come to the point where having noticed the attractive and aggressive advertising of one of his home electrical contractors, he has come to the conclusion that he will send for this man and find out just what it will cost to install this service in his home.

The contractor when arriving at the home or office of the prospective customer, finds that the owner has not mapped out any definite ideas, either with respect to the amount of current he requires, or the kind of a system he wishes installed. Let us begin at this point therefore, and suggest a manner in which this may be taken up.

We begin by indicating that the cost of wiring a building may vary between wide limits. The cheap method consists of what is known as knob and tube work, and is usually accompanied by overhead service and meter and a minimum number of switches and receptacles. The good method consists of a BX job with a proper proportion of switches and receptacles, together with a reasonable allowance for future increase. With respect to knob and tube work, let it be said at the outset, that in but few cases will it be found necessary to install work of this character if a proper presentation be made of all the advantages and benefits of flexible steel. The knob and tube job can be installed somewhat more cheaply, but the difference is not nearly so great as is frequently imagined. As a general proposition, it may be stated that with the same degree of experience in installing both classes of work, a BX job may be installed on an average cost of not more than 40 per cent. in excess of the knob and tube. Especially is this true where three-way switches are involved. In about two cases out of three, an owner will pay this difference, provided the great advantages of the better system are made clear to him.

In the first place, the material is practically permanent. It is fool proof. It cannot be tampered with without proper tools and experience, and is therefore, safer. It can be installed with a great deal less tearing up, since a 2-inch floor board will easily accommodate 2 or more circuits. In running double three-way circuits through halls, the knob and tube work frequently requires taking up three or four feet. Furthermore, with a knob and tube job at each outlet it is necessary to cut the plaster away, with the result that there is constantly a working loose of the plaster for many years after. Furthermore, it opens the ceiling and adds to the fire risk. With a BX system, the outlet is closed by a steel box and is finished off in a workmanlike manner. While the proposition of rats gnawing off the insulation of a wire may seem more or less mythical, the writer has seen No. 14 copper wire completely cut in half by rats, and the insulation eaten off for a considerable distance. This is impossible with a BX installation.

The risk of shock is also less with a properly grounded BX system and with nervous or sickly persons, this is an important point.

The service in all cases should be brought in to the basement. In many localities the upstairs meter is prohibited. Even if not however against the company's regulations, under all ordinary conditions, the proper place is the basement. In many cases, and where the pole is close to the building, the strictly underground service is strongly to be recommended. The owner will appreciate this suggestion afterwards, if he does not at the time. Under ordinary conditions, however, it will be necessary to jump the service to the house, and in that case the service conduit should extend to the eaves of the building, in no case should be stopped half way up, or in the middle of a blank space. The greatly improved appearance of a conduit in which the service cap is under the eaves, or some corresponding point on the building, easily compensates for the slight additional cost.

The distribution cabinet or cutout box should be located in the basement. The practice which has survived for many years, and which is a relic of the older days of No. 12 wire for branch circuits and Carbon lamps with their large current consumption, not to speak of the crowding of these branch circuits, follows a condition which no longer exists, and a custom which certainly should be obsolete. Manifestly the cost of the ordinary steel box in the basement is less by one-half to two-thirds than the flush wall box in the second hall or closet with its door front. Also manifestly, the cost of carrying the circuits to the basement box is less than they would be to the second floor box. Finally, the convenience and desirability of the arrangement, to the customer, is much greater, since it is not necessary to have the repair man come into the house, always at the most inopportune time to make repairs when the lights are out. This is work which should be done in the basement. For these reasons, we invariably recommend the basement box. Another advantage on the side of economy, is that in a great majority of cases, it is quite a little cheaper from the standpoint of actual material involved, than would be the case of the upstairs box.

It is an excellent plan in connection with a meter loop, to purchase standard meter boards, rather than leave your men to nail up broken boxes or other material, which they may find on the job. The effect of the lighting company also is good, and it adds to your reputation in giving a finish to the job and indicating a thoughtfulness for details which is frequently absent in your competitor. These meter

· From National Electrical Contractor.

boards may be purchased for a small sum, not over 25 cents, and surely this item is one which any job will stand.

Do not crowd your circuits. If your lights total 32, do not place them on two circuits, even though the rules will permit. It is much better to split this into at least three circuits, and thereby allow the owner room for extensions without relatively high cost after the original work is completed. Frequently, the addition of an extra circuit means absolutely nothing in branch wiring, and is simply summed up in a matter of 15 or 20 cents for a double branch block in place of a single.

When you take up the matter of switches, there are several points to be considered. First, do not install snap switches in any case except where there may be dampness and the appearance does not count. Secondly, use nothing but the highest grade of flush push button switch. Preferably, use solid plates, especially where it is a case of a house already built. An experienced eye will detect a struck-up plate every time, and the excuse given that it is in reality better because inequalities of wall surface in most cases suggest the use of such a plan, is in reality a confession of faulty work. In no case need this condition affect the job adversely, provided the switch is not set too far front.

In recommending switches, we should bear in mind that invariably the mistake is in supplying too few and not too many switches. Certainly, there should be a three-way circuit for the front portion of the house, and also the rear servants' stairs, if the owner can be induced to install it. Do not forget that switches save money every day in the year, and that their first cost is the last cost. This argument appeals to any house owner, although they may not think of it if you do not mention it. The switch for the dining room is a necessity, since the average maid cannot reach across the table to the fixture. If she does, it is usually at the risk of breaking glass or china. Furthermore, bear in mind that the tendency to-day is very largely towards fixtures close to the ceiling, particularly not the low pendant type we have been familiar with for many years and in all such cases, therefore, we are obliged to use the switch. If it be suggested that chain sockets may be used, this may be disposed of with the statement that they are highly inartistic and particularly mar the effect of a fixture which is high up. Also they are mechanically defective, in that with ordinary careless handling, the chains frequently break. A chain pull socket under such circumstances is an excuse and attribute to poor workmanship.

In bedrooms where there are side brackets, we should invariably recommend switches where these brackets are on the opposite sides of the room, since intervening furniture makes it necessary to go through the room in the dark. In addition to the fact that many women are timid about entering bedrooms in the dark, especially if alone in the house, the added reason of stumbling over furniture frequently decides the question.

With respect to closets, by all means recommend a light if these closets are of sufficient size to warrant it. The closet light next to the cellar switch is the greatest convenience in the house, and one for which the owner will remember you longest.

Many Advantages of Receptacles

With flush receptacles, by all means do not fail to present the many advantages which these devices possess.

Do not fail to locate at least one on each principal floor for the vacuum cleaner. If the owner hasn't a vacuum cleaner, he almost certainly will have following his introduction of electric service. Frequently if the work has to be cut down in cost, these may be made to serve a double purpose by locating one in the dining room conveniently near the serving table. This will usually reach most places on the first floor, and will at the same time afford a proper connection for heating and cooking devices. In this same connection, and for the same reason, locate a receptacle in the laundry or kitchen, as the case may be. Call attention to the fact in locating flush receptacles for these purposes, that while most electrical devices are advertised as being convenient for connection to an electric socket, in no case does it pay to so use them. The capacity of the wire in a fixture, usually No. 18, as compared with the capacity of the circuit wire in a receptacle, which is No. 14, is such that motor driven devices do not receive proper voltage, owing to the small size of the wire and heating devices for the same reason are deprived of a proper voltage. In the case of the motor, it means reduced speed, and therefore, reduced capacity and in the case of the heating device, it means a great impairment of the efficiency of the apparatus, especially the speed.

The result in both cases is a considerable increase in the cost of the apparatus, or rather the use of it to the customer. If these arguments be advanced, it is a very easy matter to obtain the owner's consent to installing at least a limited number of receptacles.

The type of receptacle should preferably be one in which the condition of the receptacle is always closed. That is to say, one that presents a flat surface and not a recessed pocket. A receptacle of the Hubbell type for example. The advantage of this, in addition to the more attractive appearance, lies in the fact that children may not stick scissors or other similar devices in these receptacles and thereby cause either serious damage to themselves or to the house. Another advantage of a receptacle of this type, lies in the fact that used in connection with the adapters that are furnished, the customer may use many devices anywhere in the house, whether on a receptacle or a fixture socket. This is frequently a great advantage, especially where lamps and other little special devices are purchased by customer when in other cities, and then brought home only to find that he cannot attach them to his system. It is well to standardize on some one receptacle rather than carry two or three in stock. You will find that your workmen at times when you are not in touch with matters, will quite frequently install two different makes of receptacles in the same house, with the consequent wrath of the owner coming back on you.

In connection with the receptacles, it is well for the reasons above stated to place them on a separate circuit, running No. 12 wire. It is not possible to fuse a receptacle circuit and come within the limits perscribed for branch circuit lighting, without constant trouble with the fuses blowing because the owner attempts to attach a chafing dish, or a radiator. For these reasons, it is best to install a circuit of larger capacity, and this can best be done by putting the receptacles on a circuit by themselves.

In figuring three-way circuits, bear in mind that the upstairs lighting is frequently a bracket fixture. In this case also, it frequently happens the switch would ordinarily come within a foot or two of the fixture. In such cases invariably employ a three-way socket on the fixture. This does away with the switch, and in addition to saving an item on the wiring cost, which is transferred in part to fixture cost, it makes a better appearing installation, and one equally satisfactory.

In figuring capacity of your mains, be careful not to spoil the good ideas you have introduced into the job elsewhere, by paring down at this point. Figure the total load on your house in amperes, and if the building is more or less completely wired at the outset, put in a wire of at least this capacity as indicated in the National Code. I am aware in suggesting this, that many contractors take a load factor in residences of not over 50 per cent. and if their connected

load therefore amounts to 50 amperes, they would figure on a wire of 25 amperes capacity.

This is at variance with the modern idea and the educational plan which is being followed out of a proper provision in house wiring for the increasing use of electric service devices. The rapid addition to the list of electrical household devices such as heating and cooking devices, electric irons, vacuum cleaners, motors for utility purposes, washing machines, ironing machines, and many other devices which are constantly being developed, makes it absolutely necessary that the electrical contractor look ahead and safeguard the interests of his customer, certainly to a reasonable extent, by providing ample capacity in the service wires.

Apart from this, consider for a moment that No. 10 wire with a capacity of 30 amperes and which would usually take care of any of the ordinary small residences, as compared with the No. 8 wire with a capacity of 50 amperes—an increase of 70 per cent.—and of which the difference in price on the 100 ft. of wire which would cover the average service, amounts to an insignificant sum.

If the owner, admitting the desirability and even the necessity for these excellent suggestions which you have made, is unable to pay for all of them at the particular time, let your service wires by all means provide the ultimate capacity required, and also arrange your cutout box of a size to provide for ample additions in the way of further branch circuits. Also, and if there is any appreciable cutting in the lighting for the upper floors with an idea that later on more wiring will be installed, it is frequently desirable to place a reduced number of lights on these upstairs circuits, so that extensions may be made later without the necessity for running new circuits from the basement.

In going over these matters with your prospective customer, you will present them in a careful, thorough and painstaking manner, and not fail to call his attention to the fact that this work naturally costs more than inferior work, and that especially in electric wiring is it true that nothing but the best is good enough. Anything else is hazardous, and will invariably prove to be unsatisfactory. Make clear to him that you can install his wiring with as little cost within reason as he feels he is able to spend, but that, however you may install it, you have but one standard of work, and that is the best. Undoubtedly many ideas other than those above mentioned will occur to you on reading of this suggested line of talk but when all has been said the fact remains that if you will adopt as your standard a high class of workmanship, the best for your customer, and will see that people who entrust their work with you are given the benefit, not only of the best work and materials, but of the best ideas at the time prevailing in modern electric service, you will build up a business for yourself, which will in a sense defy competition. You will find people will come to you because of the fertility of your ideas, and your reputation for high grade work and fair dealing. This means not only a good business, but a profitable business, and after all that is the goal which we all seek.

Joint Orders a Pernicious Principle

Editor, Electrical News:

In a recent issue of the Electrical News (Aug. 15) appears a news item to the effect that the Canadian Electrical Association is taking steps toward placing joint orders for electrical supplies.

It is regrettable that the attitude of the C. E. A. could not be more fully reported at that time, for a practice so pernicious in principle as that proposed should certainly be nipped in the bud. It is hoped that a discussion of the subject will aid that end.

As far as the present report goes, most of the member companies of the C. E. A. apparently feel that they will benefit themselves by this practice and be able to extend that benefit also to "the man on the street who buys electrical utilities and supplies from the organization which supplies him with light and power."

This wording is somewhat ambiguous, for "the man on the street" may refer to the ultimate consumer or the so-called screwdriver or curbstone electrician—species carpetbaggus. But whatever construction is intended, the proposed practice must make for the elimination of the jobber and dealer through direct purchase from the manufacturer. This is the certain outcome of co-operative buying.

In a country of extensive municipal ownership of public utilities it would also tend toward municipal trading as due to the desire for self-preservation on the part of these plants they would have to follow the lead of the private corporation members of the C. E. A. Its influence would be along the line of an extension of municipal ownership.

All are agreed that in the interests of a perfect, which is to say continuous, service, the screwdriver electrician should not exactly be encouraged. On the assumption that a considerable impetus has been given to the electrical supply business by private enterprise, the scheme proposed might confer an immediate temporary advantage—a kind of theft of the reward of initiative and enterprise—especially (opposite as the statement at first appears) if launched in times of general prosperity. It might in some isolated instances prove a permanent advantage, but would in general speedily degenerate into the clog which conservatism naturally is. It must be remembered however that the combined efforts of the electrical jobbers and dealers as distributors, especially if aided by active co-operation on the part of the central station, have achieved a considerable measure of success in advancing the progressive use of electrical energy. The province of the jobber has been largely one of financing the dealer who from myriad centres distributes the various electrical appliances and energy using devices to the ultimate consumer. Large business institutions have come into growth as a consequence and these have borne the brunt of the cost of progress as many valueless stocks of unsalable obsolete material go to show. Private enterprise plus competition compels all to keep pace with progress no matter what the cost.

This does not, however, result in a direct tax upon all consumers, but it is possible that whatever money is invested by central stations in this proposed supply business would become part of their capital and as such entitled to and expectant of an annual return.

This situation has a parallel in the case of the consumer of "juice" from a municipal plant who gets a low kilowatt-hour rate but pays more than the difference in interest on bonds and so forth. Even though economy of distribution obtain it would be undesirable if the quality of the service rendered by the distributors were thereby impaired. The elimination of the numerous middlemen would certainly reduce the number of distributing centres; of skilled salesmen (sales engineers); and would make for delay. Loss of time is an infinite expense.

Co-operation in the sale or purchase of commodities is undesirable. Municipal ownership may be used, almost without exception, to show that co-operation may mean conservatism and make for business stagnation. Co-operation should obtain in the perfecting of product and in the determination of that which is most desirable, and competition in the marketing of that product both now and always. Competition eliminates the sluggard and viewed rightly makes for business health and acuity. This is the nation's prosperity.

A central station can show interest in its customers

best by disseminating information among them regarding the scope, use and desirability of electric appliances; the proper method of installation and their economic use. Such educational work is a legitimate sales expense and would prove an advantage to all. Where invention causes such rapid changes and the sale of electric energy is to be practically perpetual, it should certainly become an important part of central station service.

To-day, the average central station sales force is lacking in enterprise and is running on the momentum of the past aided by the effort expended by the jobber and dealer introducing new and improved lines. The central station should create business for those concerns legitimately engaged in the supply business, or this would net big returns. Increased current consumption without any appreciable increase in investment is the principal advantage to the central station.

The final outcome desired by the C. E. A., viz., standardization, is also a questionable advantage, for extreme standardization impedes progress. Manufacturers' associations and engineering societies are keenly alive to the requirements of this situation and may well be entrusted with its solution, but no matter how selfishly they may be inclined, they will certainly not endeavour to so standardize purchases that whatever is new, will be excluded. This too is a possibility of the plan of the C. E. A.

This letter caroms pretty well all around and over the subject, but should it start a discussion its object will have been achieved. Knowing that you have the interests of the jobber, the dealer, and the central station at heart, a discussion of this subject should be started through the channels of the Electrical News that all may be benefitted to the fullest extent by whatever action is finally decided upon by the Canadian Electrical Association.

Yours very truly,

H. E. Grant.

Vancouver, B.C.,
September 15, 1914.

Getting Old Houses Wired

An interesting paper was recently presented by Mr. E. C. Kimball of the Boston Edison Company before the New England Section of the National Electric Light Association, describing a campaign carried on by this company to secure the installation of electrical equipment in old houses that had not been wired. The paper describes a "single outlet" offer made to this class of consumer, which included one outlet for each customer at any desired point on the ground floor and for which the customer contracted to pay $2.35 down and $2.00 per month for six months. The idea underlying this offer was that a more complete installation would be immediately required and the results show that, in the nine months ending July 31st, 1914, the company signed 918 new contracts, adding 7,000 50-watt equivalents to the connected load, for which the estimated income is $21,000. Of the 918 contracts obtained, only 29 were for the single outlet alone. Individual equipment was ordered varying all the way up to $200 and the average contract amounted to approximately $83. It is calculated that the company's financial investment will be taken care of in 15 months.

The paper states that the wiring contractors in the city were not favorable to this plan at first, but that later they have quite fallen in with idea and are willing to do the work at the arbitrary price named by the company. Indeed, it is said a number of these contractors keep in daily touch with the company, to see if any new work is offering. These contractors, in fact, are advance agents for the company, and are encouraged to bring in new work by being allowed $2.00 for each new customer secured, plus 25c. for each outlet the customer contracts for. In this way 248 contracts have been obtained at a compensation of $1,265, or at the rate of $5.10 per house.

More Flush Receptacles

Further illustrations of the various types of flush baseboard receptacles, in addition to those in our issue of September 15th, are given below.

Fig. 33 shows a receptacle manufactured by the Arrow Electric Company. Figs. 34 and 35 are the plugs for this receptacle. The inside of the receptacle is grooved so that it

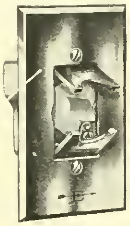


Fig. 33

Fig. 34

Fig. 35

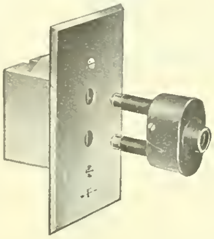


Fig. 36

can be used with a polarity plug as well as with the standard plug. This is an advantage where a fixed polarity of current is required. The standard plug illustrated is interchangeable with other makes of plug of this design.

Fig. 36 is an Arrow automatic door receptacle. The doors in the plate open and close automatically with the insertion and removal of the plug. These doors prevent dust and moisture from getting into the interior of the receptacle, and conceal the live contacts when not in use.

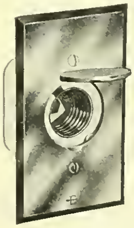


Fig. 37

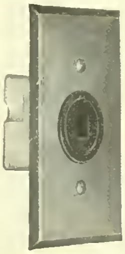


Fig. 38

Fig. 39

Fig. 37 is a screw plug flush receptacle, also manufactured by the Arrow Electric Company. This unit is adapted for use with any standard Edison base attachment plug. The plate shown is made with a hinged door so that the interior of the receptacle may be covered up when not in use. The Arrow E line is handled in Canada by the Northern Electric Company.

Fig. 38 is a type of separable plug receptacle manufactured by the H. T. Paiste Company. The opening in this receptacle is rectangular in shape which, it is claimed, renders it easier to find the opening and insert the plug as, for example, when the receptacle may be wired in a dark corner. The contact springs are in the base, safe from breaking or bending. These are phosphor bronze to ensure long life and a firm and even grip.

Fig. 39 represents a receptacle similar to Fig. 38, except that the contact part of the face recedes slightly and is covered by a folding door, improving both the appearance, the cleanliness and the safety of this receptacle.

Fig. 40 is similar to Fig. 38, except that the rectangular base is replaced by a round base.

Fig. 41 is a Paiste receptacle adapted for a screw plug.

When the plug is removed, a door fits down as in Fig. 39.

Fig. 42 represents the plug used with Figs. 38, 39 and 40.

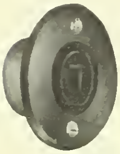


Fig. 40

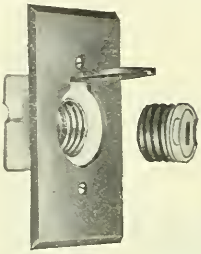


Fig. 41

Fig. 42

Fig. 43

In this figure the strain relief wiring is indicated, before the protecting fibre is pushed on.

Fig. 43 represents represents the well-known Diamond H flush receptacle.

Gain to Canadian Manufacturer

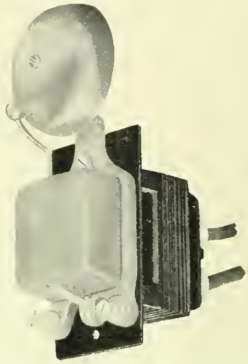
As noted in our last issue, Boving & Company of Canada have secured an order for two hydraulic presses from the Electric Power Company for the Northumberland Pulp Company, a subsidiary. Boving & Company are also building a similar press for a company in New Brunswick. These presses have special features worthy of comment, as they are more or less designed on the latest and most approved German practice, where the building of hydraulic presses has been brought to a very high state of perfection. Incidentally, this illustrates one of the advantages certain to accrue to Canada from the present appalling European war, inasmuch as, in the ordinary course of events, these presses could be imported from Germany at a lower price than they could be produced here in Canada, and, consequently, the order would likely have gone to the foreign country.

No cast iron enters into the construction of these presses, the material being entirely of steel throughout; no foundations are necessary. These presses are not subject to any deformations due to the stresses to which hydraulic presses are generally put, and have a very high factor of safety. They are suitable for all purposes for which hydraulic presses are required and, while costing slightly more than the imported German article, are nevertheless cheaper than the ordinary hydraulic presses usually constructed on this continent. These presses can be built up to 1,500,000 lbs. pressure.

Hylo Mazda Lamp.—The well-known Hylo lamp with carbon filaments has now been duplicated in the higher efficiency tungsten lamp. The large filament in this lamp takes approximately 25 watts and gives 20 c.p. The small filament gives about 1 c.p. with a use of about 15 per cent. as much energy, or say 4 watts. Though this is not a particularly efficient low light, it is a considerable saving over burning a high c.p., and is also much more agreeable where a night light is required. These lamps are manufactured by the Economical Electric Lamp Division, National Quality Lamp Works of the General Electric Company, New York City, N.Y.

Transformer Fits Standard Box

The Transformer illustrated herewith is designed to be installed in a Standard flush switch box for flush work or they may be reversed and mounted on the surface in the regular way. They are of special value for residences where it is desirable to place the transformer near the bell and where the ordinary transformer would be unsightly. The transformer plate is drilled and tapped to take any standard iron box bell. It will also take a standard flush switch plate where it is desired to make the finish conform to finish of the hardware.



The coils are independently wound and designed to withstand a 2,500 volt insulation test between primary and secondary and primary and ground, also 1,000 volts between secondary and ground. The transformer will not burn out an a continuous short circuit of the secondary. Frequency, 60 cycles—primary voltage 110, secondary voltage 10. It is constructed to comply with the National Electric Code and is approved. Manufactured by A. E. Rittenhouse Company, Honeoye Falls, N.Y.

New Line of Cable

The Trumbull Electric Manufacturing Company, Plainville, Conn., are placing on the market a new line of armored cable illustrated in the accompanying cut. This new line is known as the Trumbull T armored cable, flexible steel conduit and armored cord. It is claimed to be high-grade in every particular, made in their own factory under standard

conditions with the best machinery obtainable. The firm say it is as flexible as any on the market and more flexible than most. This line can be furnished in either twin or three conductor type, in stranded wire or lead covered.

The Monarch Electric Company, St. Lambert, P.Q., have recently placed on the market a new type of pull chain, pendent socket of very substantial and simple construction.

A New Electric Washing Machine

The Invincible Manufacturing Company, Pittsburgh, have recently put on the market a washing machine of an entirely new type. The clothes are placed in a cylinder, but instead of revolving in the usual manner the cylinder of this washer oscillates on its vertical axis. This motion drives the suds back and forth and subjects the clothes to a very vigorous cleaning action. Furthermore, there is no tendency for the clothes to form into a ball; in fact clothes tightly matted together can be put into the cylinder and the machine will untangle them. A special feature is a perforated box which

runs along the bottom of the cylinder; at this point the suds are practically quiet so that all sand, grit and foreign matter collects here, without being constantly distributed through the clothes, and can be run off through the drain cock. The wringer is reversible and has a quick release by means of which the pressure on the rollers can be instantly released should the clothes tangle or the fingers be caught. The cylinder is of copper, heavily tinned inside. The drive is very simple and offers no danger to the most careless operator. Power is supplied by a 1/8 h.p. Westinghouse motor, which can operate wringer and washer at the same time.

A Water Power Act

The United States House of Representatives have passed a water power act known as the Adamson Bill, and the matter will now be considered by the Senate. As the bill now reads, it outlines a practical and well-defined programme by which water powers on navigable rivers can be utilized. It provides that the Secretary of War can authorize developments in accordance with plans approved by the chief of United States engineers. This guarantees that navigation interests are conserved, the greatest power possibilities utilized, and the commercial character of the enterprise safeguarded against abuses frequently associated with trusts. The water power privilege thus granted runs for a period of 50 years, after which the government may take over the plant, together with the transmission and distribution system, on a fair business basis. The government does not propose to exact any tax for the water power privilege, but a proper share is to be paid for betterments of flow conditions resulting from government storage or regulating works.

New Receptacle Fitiings

The accompanying figures show a number of newly approved standard receptacle fittings being placed on the market by the Appleton Electric Company, Chicago. Fig. 1 represents a one-piece weatherproof, porcelain receptacle for use on ½ in., ¾ in. and 1 in. rectangular steel unilets; note the shade-holder groove. Fig. 2 is same as Fig. 1 but without the shade-holder groove. These receptacles are secured to the body with two screws. Figs. 4 and 5 represent one-

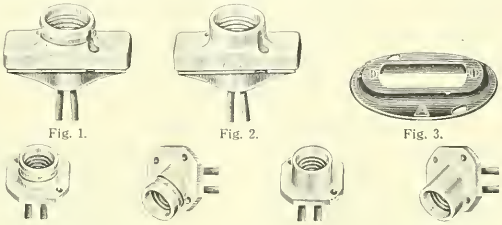


Fig. 1. Fig. 2. Fig. 3.
Fig. 4. Fig. 5. Fig. 6. Fig. 7.

piece, weatherproof, porcelain receptacles with shade-holder groove, for use on ½ in., ¾ in. and 1 in. octagonal steel unilets; secured to body with two screws. Figs. 6 and 7 also represent straight and angular types of this receptacle, without the shade-holder groove. Fig. 3 is a push-button switch cover for use on a 4-in. round outlet box. It will take any of the standard push-button switches, flush rotary switches or plug receptacles.

Electric Cuspidor Polisher

The Helcomb electric cuspidor polisher, illustrated herewith, is one of the latest electrical time savers for use in the office building, hotel, public building or factory. This outfit has changed a job which formerly took a lot of time and hard labor into a task of but a few minutes. It is claimed by the manufacturers that the average time of pol-

ishing a cuspidor with the outfit is about one-half minute. It is also claimed that it eliminates the danger of denting the metal and that a much higher polish can be obtained than is ordinarily possible where cuspidors are polished by hand. In the large building where there are hundreds of cuspidors to be polished every few days, the saving in time and labor is a very considerable item. The outfit is manufactured by the J. I. Helcomb Manufacturing Company, Indianapolis, Ind. It consists of a rotating disc with an

automatic centering clamping device which holds the cuspidor. The cuspidor is held against a revolving disc by a plunger supported from an iron brace above. The plunger rod does not turn, the block on the end of the plunger being mounted on a belt of ball bearings. The disc is belt-driven by a motor which is mounted in the base of the truck. The truck is made of oak and is mounted on light running rubber tired castors. In addition to the disc for holding cuspidors, the outfit is supplied with a buffing wheel and grinding disc, for buffing silverware, grinding cutlery, etc. When used as a grinder or buffer the outfit is stood on end. The outfits are equipped with one-quarter horse power, 1,750 r.p.m. motors, manufactured by the Robbins & Myers Company, Springfield, Ohio.

Multi-Point Switch for Electric Ranges

A new snap switch brought out by the Bryant Electric Company, of Bridgeport, Conn., for use with electric ranges and other heating appliances is arranged to be so connected that instead of increasing the number of coils or elements in circuit beginning with "low heat," as has been the general practice heretofore, the new arrangement gives the greatest heat in the first position of the switch. In other words, beginning with the switch in its "off" position, the first twist of the knob throws into circuit all the heating elements it controls. The second position cuts the heat down to medium, the third to low, and the fourth is the "off" position. In this way the degrees of heat are provided in the order in which they are most frequently desired, the heating device is more quickly brought to full operating temperature, and, since the current to be broken at any step is small, a very much smaller and more compact switch can be used. An indicating dial, showing the position of the switch, is set at an angle of 45 deg. so as to be visible from any position in front of or above the switch.

Multi-Point Snap Switch for Heating Devices.

The Cutler-Hammer Manufacturing Company announce that the first Cutler-Hammer electric steering gear to be used in a foreign navy, is on the Greek battleship "Kilkis." This ship, purchased from the United States, was formerly U.S.S. "Mississippi." The "Kilkis" is reported as having arrived safely at Athens.

Pass & Seymour, Inc., are distributing, in miniature form, a photographic reproduction of their catalogue No. 22. The prime object of the smaller catalogue is to provide information in a vest pocket size, which does not unduly crowd the pocket, and which one can have always on hand.

Trade Publications

Progressive Manager.—Folder issued by the Transmission Engineering Company, Pittsburgh, Pa., illustrating their outdoor switching stations.

Electric Heaters—The National Electric Heating Company of Toronto are getting out a new circular on electric ranges, air heaters and luminous radiators.

Strain Insulators and Clamps.—Bulletin No. A 4200, issued by the Canadian General Electric Company, describing and illustrating strain insulators and strain clamps.

Unilets conduit fittings—small booklet issued by the Appleton Electric Company, Chicago, Illinois, fully listing and illustrating their complete line of these well-known fittings.

Rail Bonds—Bulletin issued by Canadian General Electric Company, Limited, describing rail bonds and rail bond tools and giving a large amount of valuable engineering data on the subject.

Electrical Machinery—Catalogue issued by MacGovern & Company, Inc., 114 Liberty Street, New York, listing and describing used electrical and steam machinery, cars, car equipment, etc., carried in stock at the present time by this company. The booklet answers any prejudice against the purchase of used equipment by publishing a long list of prominent companies and others to whom they have sold apparatus.

Small Lighting and Charging Units.—Booklet issued by the E. L. Russell Company, Indianapolis, Ind., describing their small lighting and charging units for service in districts where electricity is not available or where the cost of current is high. These units consist of a "silent valve," single or twin-cylinder engine, depending upon the capacity of the generator. The standard size lighting units have capacities of 35, 75 and 150 16 c.p. lamps.

Electric Heating—Catalogue No. 19 issued by the Simplex Electric Heating Company, Belleville, Ont., illustrating and describing their complete line of standard heating apparatus, including several new heaters for various commercial purposes. The first 40 pages are given up to household devices and ranges, and the balance of the catalogue, some 55 pages, shows purely commercial apparatus and indicates a great number of factory lines useful where electric current is available.

Direct Current Test Meter—Bulletin 46390 issued by Canadian General Electric Company describes a portable test meter combining in one standard several capacities covering a range from light load to full load which makes possible rapid testing since no time is lost in changing standards. The electrical element is similar in design to that in other C. G. E. direct current meters. The meter is furnished in two distinct ampere ratings, 1, 2, 10, 20, 40 ampere or 5, 10, 50, 100 ampere each with single 110 volt or double 110/220 volt potential windings.

Ornamental Incandescent Street Lighting—Bulletin B-3310 issued by Canadian General Electric Company describes the Novalux units recently added to their line of ornamental street lighting fixtures. They are made for both series and multiple operation and will accommodate the 400 to 600 c.p. 6.6 ampere and the 600 and 1,000 c.p., 20 ampere sizes of series mazda lamps and the 500, 750 and 1,000 watt multiple mazda lamps. The individual compensator mounted inside the ornamental casing of the series unit permits the use of the 20 ampere mazda lamps on 6.6 or 7.5 ampere circuits. As the efficiency of this high current lamp is much better than the straight series, about 25 per cent. energy is saved. This allows the Series Novalux Ornamental Units to be connected in existing circuits and permits an additional number of lights to be used without adding to the station equipment.

Current News and Notes

Bury, P. Q.

The power line of the Westbury Electric Light & Power Company has been completed from their power house near East Angus to the village of Bury, which is now supplied with electric light and power.

Calgary, Alta.

The Powell River Company, Limited, has been registered under the Ordinance of the North Western Territories respecting Foreign Companies.

The Canada West Electric Company, Limited, has been registered under the Ordinance of the North Western Territories respecting Foreign Companies.

The Weno Power & Light Company will make application at the next session of the Alberta legislature for power to construct the necessary transmission lines for the transmission of electric energy along and upon certain road allowances in a number of townships named.

Chatham, Ont.

On October 12th a by-law will be submitted in Chatham, authorizing the expenditure of $90,000 in the erection of a hydro-electric sub-station and distributing system.

A by-law authorizing the expenditure of $90,000 on a sub-station and distributing equipment will be voted on October 12th.

Cornwall, Ont.

A by-law will be submitted October 14th, authorizing the Council to grant a twenty-year franchise to the Cornwall Street Railway, Light & Power Company.

Hamilton, Ont.

The fire which recently occurred at the plant of the Canadian Tungsten Lamp Company, Cannon Street, Hamilton, only did a very inconsiderable damage and did not interfere in any way with the work.

Kingston, Ont.

The Kingston Utilities Commission are again negotiating with Mr. J. M. Campbell for the supply, in bulk, of 500 h.p. of electric energy; this to be generated by Mr. Campbell at Kingston Mills.

Kingston's new White Way, consisting of 96 6.6-ampere magnetite arc lamps, has been in operation some three weeks. The citizens are highly pleased with the new installation.

Lachine, P.Q.

This town has awarded the contract for a motor-driven turbine pump to E. Laurie & Company, Montreal.

Montreal, Que.

A contract has been awarded to the Beaver Electric Company, Montreal, for the electrical work required in connection with alterations to the factory of J. C. Wilson, Ltd.

A particularly smart piece of work in the way of installing electrical machinery and erecting poles, etc., has just been carried out at Sheds No. 24 and 25 on the Montreal Harbour. The Government decided to fit up these sheds for baling compressed hay for the cavalry which are going to the front, and to obtain the necessary electrical power, a new line had to be constructed and machinery installed. By working day and night the poles were put up, the buildings wired, and the machines installed in a very short time. Sixteen very heavy compressing machines are now in operation. These are electrically driven, the current being supplied by the Montreal Light, Heat and Power Company over a special line. It is transformed from 2200 volts to 550 volts, three 75 kw. transformers being used. The Government purchased four 100 h.p. Canadian General Electric motors, each motor driving four compressing machines. The small sub-station in which the transformers are located was partially built, and the remainder of the work was done under great pressure. Much of the work is naturally of a temporary character to meet the present emergency, but later it is intended to make it permanent in order to take care of the shipping in the sheds and of lighting a portion of the harbour.

Dr. L. A. Herdt, of McGill, and chairman of the Montreal Electrical Commission, has left for Europe, on private business. He will be away for several weeks.

The Canadian Light and Power Company, Montreal, have just about completed the fourth installation at St. Timothee, P.Q., and expect to have this in running order the first or second week in October.

The Montreal Electrical Commission have made arrangements to continue work on the conduits, the contracts for which are all held by Mr. G. M. Gest. The Montreal Public Service Corporation commenced the work of pulling down their poles on St. Catherine St.—the first thoroughfare on which conduits were laid—on August 24 and are proceeding with the work, in order that connections for lighting and power purposes may be made as soon as possible. The same company are also taking down their poles on Bleury street. The poles were originally installed by the Saraguay Electric and Water Company, the Dominion Light and Power Company, and the Montreal Electric Light Company.

The marriage of Mr. C. P. Waterous, superintendent of the Waterous Engine Works Company, St. Paul, Minn., with Miss Fanny Nagle, daughter of Mrs. F. A. Nagle, 61 Chesterfield Avenue, Westmount, was celebrated in that city on September 16. Mr. Waterous is the grandson of the founder of the well-known Waterous Engine Works Company, Limited, Brantford, Ont., of which the St. Paul plant is a branch.

Montreal electrical interests have been large contributors to the Canadian National Patriotic Fund. A special campaign was undertaken by all classes, with the result that in five days the sum of about $1,500,000 was raised. Mr. H. S. Holt, president of the Montreal Light, Heat and Power Company, strenuously supported the campaign, and presided at one of the luncheons organized to boost the fund. The following are among the large contributions: Bell Telephone Company, $20,000; employees of the same company, $12,800; Montreal Light, Heat and Power Company, $10,000; Mr. H. S. Holt, $10,000; Shawinigan Water and Power Company, $10,000; Montreal Tramways Company, $10,000; employees of the Montreal Tramways Company, $8,000; Northern Electric Company, $5,000; employees of Montreal Light, Heat and Power Company, $3,500; J. E. Aldred, president of the Shawinigan Water and Power Company, $1,000; Alex. Pringle and R. E. T. Pringle, $500; employees of the Montreal Public Service Corporation and Canadian Light and Power Company, $555. Mr. H. S. Holt states that the donation of the Shawinigan Company was given on the motion of two United States citizens at the meeting of the directors. Mr. Holt also states that on the same initiative the directors have agreed to make a further subscription should it be needed.

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Municipal Control vs. Ownership

As between private ownership of electric railways—which, in the eyes of the public, often means a sacrifice of good service for the sake of dividends—and municipal ownership and management—which, in its effort to serve the public at a low cost, often results in financial failure—there seems to be a middle course, a sort of partnership arrangement which is working out fairly satisfactorily in a number of cities in the United States. This course is a combination, varying in the different cities, of private ownership and municipal control and appears to have met with a very gratifying measure of success in Cleveland, Chicago and Kansas City.

In spite of the strong wave of municipal ownership feeling that has swept Canada in the last few years, there has always been a strong conservative, practical element among our citizens, who, though they recognize the force of the municipal arguments in theory, still are unconvinced—owing to certain human weaknesses, which we all deplore, of course, and will probably remedy in time—of the workableness, at the present stage of human development, of such a scheme in practice. This conservative element believes in the middle course and points to such a successful Canadian example of the above-mentioned partnership arrangement as the Consumers' Gas Company of Toronto. This company is restricted in its dividends to a certain percentage, and earnings in excess of this amount are used to reduce the price of gas to the consumer; the city owns a percentage of the stock of the company, and has representation on the board. Friction between the consumer and the company is very rare and the price of gas is so reasonable that it has constituted in the past a very real competitor to electricity—this indeed is still true in the item of cooking.

Mr. Bion J. Arnold, chairman of the Board of Supervising Engineers, Chicago Traction, and well known in Canadian electric railway circles, writes an interesting article in the current number of the Electric Railway Journal, reproduced elsewhere in this issue, on the "Financial Relations Between Cities and Utilities," in which he states that, during the past seven years, the railway companies of the city of Chicago have paid about $14,000,000 in cash into the city treasury, and estimates that this fund, with accrued interest, will amount to approximately $90,000,000 by the end of the twenty-year franchise. Commenting on the Kansas City plan, Mr. Arnold also says:—"Kansas City has the best solution of the partnership arrangement so far worked out." By this arrangement the company is allowed to pay 6 per cent. only on a fixed property valuation, all excess being placed in an amortization fund to be used in gradually reducing the intangible value of the property.

New Offices of "Electrical News"

The illustration herewith shows the new offices of the Electrical News in the MacLean Building, 347 Adelaide Street West (east of Spadina Avenue), Toronto. Readers

New offices, Adelaide and Charlotte Streets, Toronto.

are requested to note the change of address. The Telephone numbers have also been changed and a switchboard installed to provide a more adequate service. Hereafter all Departments will be reached by calling Adelaide 2700.

Correct Store Lighting

There is a harvest at this season of the year for the central station and the electrical contractor in the better lighting of stores of all kinds. In our cities and larger towns, tremendous progress has been noted in the last year or two, but there are many of the smaller towns and villages where the idea of brightening up has scarcely penetrated. Perhaps the process of education is a tedious one, but possibly also, in some cases, the central station manager has not sufficiently appreciated the possibilities of store and window lighting in the way of increasing his revenue.

This is especially true of window and sign lighting, which is not, in the main, a peakload proposition. Rightly

or not, people are on the streets at night, generally with an open mind, ready to grasp impressions the progressive storekeeper offers through his window displays. This is the time sales are really made, if the customer sees what he wants, although the actual exchange of money and merchandise may not take place until the next day or at a later period. The point we wish to emphasize is that a well lighted window display is the best possible method the merchant can follow of advertising. The failure of a retailer to make his windows attract, invite and advertise, as long as there are people on the street to look at them, is about equivalent to buying space in the local paper and leaving it blank, or to distributing blank circulars. Are the central station men driving this fact home with sufficient force and frequency?

We ask particular attention to a splendid article on store and window lighting and decorating in this issue's Illuminating Section, by Mr. E. N. Hyde. In this article it is, of course, taken for granted that the retailer has already learned the value of his windows and Mr. Hyde simply points out, in a scientific way, how he may make the most of his advertising. The windows treated of in this article have special reference to the boot and shoe business, though the application is general. A brief space is also given to the various types of reflectors now available. In equipping the store window with lights and reflectors, it must be borne in mind that the quality of the illumination is quite as important as the quantity of light.

Business As Usual

In order to obtain a general expression of opinion on electrical trade prospects in Canada, the Electrical News recently addressed a brief request to a limited number of prominent Canadian electrical men. So far as replies have been received to date, there is no sign of pessimism, but instead, a strong underlying tone of confidence that Canada will emerge from the present period of depression as a much more important country in the eyes of the world than she was before the war began. One of these letters is from Mr. T. Ahearn, president of the Ottawa Electric Company who closes a very hopeful letter with, "All that is required is faith in the resources of our country and confidence in the ability of Canadians to develop these unbounded resources."

Two typical letters are those received from Mr. George Kidd, general manager of the British Columbia Electric Railway Company, Vancouver, and Mr. Geo. C. Rough, secretary and sales manager of the Packard Electric Company. Mr. Kidd writes:

"I look forward with confidence to the prospects for business in the future, and believe that the present temporary halt in the development of the West will in the end prove very beneficial to all concerned, as it will give us an opportunity to thoroughly overhaul our various undertakings preparatory to the further development which we believe will take place at no distant date, and should be very materially assisted by the increase in trade which we all hope Canada will enjoy on the termination of hostilities in Europe."

Mr. Rough heads his letter "Business as usual," and is evidently taking as his motto "Don't talk war, talk business." We quote the following from Mr. Rough's letter:

"We are not by any means going around clothed in a cloak of gloom and pessimism, nor are we trying to 'jolly' ourselves into believing that we are floating on the silver clouds of optimistic enthusiasm, but we are doing business as usual, quiet, sober and industrious like; looking forward with all confidence to the future, and that future, we believe, not very remote, when trade conditions will not only become normal, but will be far beyond anything that the rapid development of our Country has warranted in the past."

Growing Times in Winnipeg

While it is generally conceded by the large business houses that a considerable falling off in business has occurred during the last month or so, the opposite would appear to be the case with the light and power business. The City Light and Power Department report that the increase in their business has been greater during the last five weeks than at any previous time since the beginning of the year. There has been a gradual increase each week from 152 new customers in week ending August 22nd, to 179 new customers in week ending September 19th. The net total number of customers on September 19th was 30,898.

This rapid increase in load has necessitated considerable new construction work. Two new 5,000 kw. generators with turbines, transformers and complete switching equipment now being installed at the generating station will be ready for use by the end of the month. This will bring the capacity of the station to approximately 40,000 h.p. One of the two new 6,000 kw. synchronous condensers being installed at the Terminal Station has arrived in the city and is now being erected. A new tie line to take care of the increased load at No. 1 and No. 2 sub-stations is being installed by the Canadian-British Insulated Company. This is 13,000 volts, 250,000c.m., 3-core, paper insulated, lead covered cable. Work on the footings of the new transmission line has been practically completed and, although the main contract for towers has not yet been let, the Dominion Bridge Company has been awarded the contract for special crossing towers.

Nothing definite having yet been done by the power companies, it is understood that a special order will be issued in a few days by Judge Robson, enforcing the adoption of the grounded secondary system of overhead distribution.

A new experiment in routeing the street cars has been tried during the last week and has caused considerable dissatisfaction to the residents in certain parts of the city. This is the third attempt to obtain a service acceptable to all, and it is now the intention to place this matter in the hands of Judge Robson, who will act in conjunction with Traffic Supervisor Lewis, Winnipeg Electric Railway Company and the City of Winnipeg in an attempt to obtain a satisfactory solution.

Standardization of Plugs and Receptacles

On other pages of this issue, we print extracts from an address by Mr. T. I. Jones before the recent annual convention of the National Electrical Contractors' Association. Mr. Jones speaks with authority on account of his wide experience with the Edison interests in Brooklyn, N.Y., but probably the most interesting topic touched on in his address was that of the inconvenience and dissatisfaction caused by the lack of standardization in plugs and receptacles. The average householder who has learned the good habit of equipping his home with electrical appliances of various sorts, has also learned to regret that the number of plugs with which a piece of electrical apparatus can be equipped are practically legion. Unless it be for the ordinary screw base no two pieces of equipment will ever, by any possible chance, be supplied with the same kind of plug. Aside from the inconvenience caused by this variety, there is the added expense and trouble involved in replacing the plug with which your new iron or toaster or kettle or sweeper may be equipped, for the plug the purchaser has standardized in his own home. Indeed, the lack of standardization has been carried to the extent often of receptacles of different kinds being placed in the same residence, to correspond, possibly, with different kinds of plugs that have been previously purchased.

With so many manufacturers in competition the ques-

tion of standardization is indeed a very difficult one. No organization is in a position to say that any certain plug and receptacle possesses qualities greatly superior to any other. As Mr. Jones points out, the only possible way seems to be to get manufacturers together, and it is difficult to foresee what could result if they did get together. The chaotic condition of this section of the electrical contractors' work is very unfortunate, but we believe at the present time no assistance can be given beyond the standardization in individual buildings and perhaps a little greater flexibility on the part of dealers themselves, so that they can supply a customer with any particular plug he may require. Beyond this, the only thing seems to be for electrical contractors and manufacturers to be on the watch for anything that may tend towards the desired end.

German Electrical Trade

The following interesting item appears in the Electrical World, New York, under date of October 3rd, regarding the unsettled state of electrical trade in Germany. One may well compare with this the regular publication of the British magazines covering the same field and the unaffected prices and delivery. A quite noticeable increase in the price of German electrical equipment is indicated. The item is as follows:

German electrical papers are reaching here. The Elektrotechnische Zeitschrift announced in a statement of editors and publishers on the front page of the issue of August 13 that for the present further issues would not be regularly published, but that larger issues would be brought out at irregular intervals.

Since then another number (Nos. 34-35) has been issued on August 27. The number of advertising pages is reduced, but the text pages do not differ from ordinary issues. There are technical articles as usual, without any reference to the war.

On the last pages of the issue of August 27 the war is mentioned. There are brief obituaries of Prof. Karl Baedeker, of the University of Jena, and Dr. Friedrich Erb, of the Telefunken company, who were killed as officers of the German army at the French frontier.

A war committee (Kriegsausschuss) of the German industry has been formed. This will act in co-operation with the government and the banks. The objects are the systematic distribution of employees and workingmen in industry and agriculture and early information on emergency laws and emergency measures of the government (for instance, a lengthening of the time allowance for replies to the patent office, etc.).

The Allgemeine Elektricitats Gesellschaft, Bergmann Company, the Siemens-Schuckert Company, the Maffei-Schwartzkopff Company, Paul Meyer, Brown Boveri & Company and others have raised prices 10 per cent. for dynamos, motors, fans, pumps, drills, starters, regulating rheostats, controllers, oil switches and traction material, and 20 per cent. for transformers and automatic circuit-breakers. For dynamos above 100 kw. and transformers above 500 kv.a. the list prices have been cancelled. Storage battery quotations also have been withdrawn owing to the shortage of lead.

An article in the Elektrotechnische Zeitschrift of August 27 shows that the countries at war in the middle of August have a population of 350,000,000. Of the business done in 1913 by Germany with this population 3¼ per cent. comprised electrical equipment. Exclusive of Montenegro, the German manufacturers in 1913 did a total business of $5,832,250 with Austria-Hungary, $5,436,250 with Belgium, $4,597,750 with France, $8,605,250 with England, $9,900,250 with Russia, and $73,000 with Servia. Of Germany's electrical exports, 34.62 per cent. was with its present European opponents.

Power House Architecture

In further reference to possible improvements in the architecture of power houses, regarding which we published certain articles and correspondence in recent issues, we have just received the following letter and photograph. It is very satisfactory to note the general opinion running through all these letters to the effect that great improvements are possible at little or no increase in cost. Such a building as we reproduce below is indeed a fine asset for any Canadian town,

A fine architectural asset for any Canadian town.

and a worthy example to its citizens, who are certain to be inspired thereby to increased pride and interest in the attractiveness of their own property.

Editor Electrical News,
347 Adelaide Street West, Toronto.

I certainly think that some of the power houses which we build might be made somewhat more beautiful at little or no increased cost and where these power houses are anywhere near civilization I think this should be done, if possible. The real difficulty is, as a rule, that most engineering offices can hardly afford the luxury of a good architectural draughtsman, and the engineering draughtsman who has in hand the design of the details of the building has not sufficient experience architecturally to do as well as he might with the material used.

The enclosed photograph shows the Electric Power Company's sub-station at Belleville, Ontario, where 44,000 volt power is stepped down to 2,300 volts for distribution in Belleville.

I think that this is a good example of a little additional money spent, producing good results as far as a trim looking station and surroundings are concerned. I hope you will go on reminding us from time to time with regard to the things that we might easily do somewhat better than they are done.

Yours very truly,
(Signed) A. L. Mudge.

Toronto, October 5, 1914.

By permission of the Militia Department of the Montreal Board of Control, Mr. Georges Janin, chief engineer of the city of Montreal, has gone to the front. Mr. Janin was formerly an officer in the French army, and came to Canada in 1892. Before leaving Montreal, he raised a corps of engineers which he will command, composed largely of young men attached to the city engineer's department. Mr. Janin has three sons also fighting in the French army.

Electrical Exports From Germany

We are indebted to the office of the Chief Trade Statistician through Mr. F. C. T. O'Hara, deputy minister of the Department of Trade and Commerce, Ottawa, for the following information regarding the exports from Germany, together with the portions sent to Canada, of electro-technical apparatus during the year ended December 31, 1912, the latest published records.

Classification	Total Exports Value Approx. $	To Canada Value Approx. $
Dynamos, electric motors, continuous current transformers, converters and and reaction coils	12,822,500	6,750
Ready fitted armatures and commutators	1,938,000	......
Accumulators and their electrodes:		
Not combined with celluloid, similar moulding materials and vulcanite	1,622,250	....
Combined with celluloid, similar moulding materials and vulcanite	193,750	......
Cable for conducting electric current and intended to be laid under water or in the earth	8,065,750	2,500
Arc lamps	673,000	2,750
Complete cases for arc lamps in combination with glass globes covered with net work or not; and parts of arc lamps	140,500	......
Reflector and searchlights	277,000	......
Metal thread lamps	11,730,500	136,750
Electric incandescent lamps, N. E. S.	865,500	27,000
Electric telegraph appliances	309,750	......
Telephones and appliances for	1,504,500	......
Electric precautionary and signalling apparatus; parts of	933,000	58,250
Electric appliances for lighting and transmission of power or electrolysis	10,584,250	16,000
Appliances for wireless telegraphy, etc.	413,250	......
Electric appliances for medicinal and dental purposes	887,000	1,500
Electric measuring, counting and registering apparatus; parts of	4,994,750	18,250
Galvanic and dry batteries and thermo-electric couples; parts of	543,750	3,250
Electric appliances for heating and cooking; parts of	327,500	500
Insulating appliances of asbestos, asbestos-paste, mica or mikanite for electro-technical purposes	180,500	......
Insulating tubes of paper	642,250	1,250
Appliances for electro-technical apparatus, N. E. S.	275,500	......
Total exports, 1912	59,924,750	274,750
Total exports, 1911	52,004,250	151,000
Total exports, 1910	54,550,250	73,750

Low Rates in Windsor

Although the latest town to join the hydro system, Windsor's rates compare very favorably with many of the older towns nearer the centre of the system. As a result of something over 1,300 contracts being signed up to start off with, a floor space rate of 3 cents per 100 feet is being quoted plus a meter rental of 4 cents per kw. hour. This is subject to a discount of 10 per cent. for prompt payment. The floor charge is also subject to a minimum charge of 1,000 square feet and a maximum of 3,000 square feet. The power rate also is exceedingly favorable for a town some 250 miles from the generating station. A basic rate of $1.00 per h.p. is given plus 3.6 cents per kw. hour for the first 50 hours use of connected load; for the next 50 hours use 2.4 cents and for all consumption above this .3 cents. This also is subject to a 10 per cent. discount for prompt payment.

STANDARD TYPES

By Charles R. Barrett

The Man Who Quits

The man who quits has a brain and hand
As good as the next! but he lacks the sand
That would make him stick, with a courage stout,
To whatever he tackles, and fight it out.

He starts with a rush, and a solemn vow
That he'll soon be showing the others how;
Then something new strikes his roving eye,
And his task is left for the bye and bye.

It's up to each man what becomes of him:
He must find in himself the grit and vim
That bring success; he can get the skill,
If he brings to the task a steadfast will.

No man is beaten till he gives in;
Hard luck can't stand for a cheerful grin;
The man who fails needs a better excuse
Than the quitter's whining "What's the use?"

For the man who quits lets his chances slip,
Just because he's too lazy to keep his grip.
The man who sticks goes ahead with a shout,
While the man who quits joins the "down and out."

The Man Who Sticks

The man who sticks has this lesson learned:
Success doesn't come by chance—it's earned
By pounding away; for good hard knocks
Will make stepping stones of the stumbling blocks.

He knows in his heart that he cannot fail;
That no ill fortune can make him quail
While his will is strong and his courage high,
For he's always good for another try.

He doesn't expect by a single stride
To jump to the front; he is satisfied
To do ev'ry day his level best,
And let the future take care of the rest.

He doesn't believe he's held down by the boss—
It's work, and not favor, that "gets across."
So his motto is this: "What another man
Has been able to handle, I surely can."

For the man who sticks has the sense to see
He can make himself what he wants to be,
If he'll off with his coat and pitch right in—
Why, the man who sticks can't help but win!

The Value of Telephones In The Bush

Primarily Installed for Fire Protection, but Usefulness Soon Demonstrated in Other Phases of Forest Work—Lines of Riordan Pulp and Paper Co.

By Charles E. Read, Jr.

The Riordon Pulp & Paper Company first considered the idea of building telephones throughout their limits, to assist in the work of Fire Protection, in the spring of the year 1912. We had heard that the River Ouelle Pulp & Paper Company, of St. Pacome, P.Q., had built and were operating bush telephones with great success and we wrote to them for information. They very kindly volunteered their assistance and offered to show a representative of the Riordon company around their lines. Advantage was at once taken of this offer and the company sent their forester to visit St. Pacome, where he secured a great deal of valuable data which governed the initial construction that summer.

When we built our first line we thought only of fire protection and not at all of assisting in our bush operations. In consequence, the first line extended up the slope of Trembling Mountain from the last "Bell" Telephone at the foot to our lookout on the peak. This line through a connection with the "Bell" gave us a direct line between our St. Jovite office (head office for the wood supply department) and our lookout man stationed on this commanding point, over 3,000 feet above sea level and 2,000 feet above the surrounding country.

This line was the most difficult of all to build, for much of the distance was over bare rock from which all vegetation had been swept by successive fires. As there were no trees on this fire-swept rock, and as it was impossible in many places to sink post holes, it was necessary to put in rock bolts, which extended well above the surface of the stone, to hold the insulators through which the wire was run. The method employed was the single wire or ground return, and it was connected with the "Bell" line through a repeating coil.

Bush Operations Facilitated

This line worked successfuly and before the next line was started, the possibilities of the telephone as an assistance in bush operations were recognized. In consequence the intended course of this second line was slightly changed so as to make it of more use in the conduct of our shanties and drives.

Our new line was built on the two-wire or metallic system and was hung from trees, poles being used only where trees were not available. We were also able to connect this line with the local "Bell" service. When these lines were completed and in constant operation, they were found to be so useful to both the work of fire protection and of wood supply that an extensive programme of building was prepared and immediately gone ahead with.

These new plans were designed to be useful so far as possible, for our woods operations, but in no case was the primary object of fire protection overlooked. The first of these new lines followed up the main Rouge River, from the end of the "Bell" service, keeping mostly to the portage road, as this made it much easier to patrol the line in case of breakdowns. Spurs were run into all the company camps, and where a big jobber was on or near the line, a box was put into his shanty free of charge. The line was run on above our last camp to the main storage dams at the head of the river. This last spring, when water was so scarce and driving so difficult, we were saved many hours of waterflow from these storages by the use of the telephone. Formerly it had taken from eight to sixteen hours for a man to walk from the head of the drive to the dams with orders for the opening and closing. With the telephone this was done by the foreman himself in fewer minutes.

As the gangs come down the river they bring their phones with them, connecting up with the line wherever they camp. In this way, orders can always be given to a gang in the shortest possible time and reports received of their progress at all times.

We also built lines up our two chief branch rivers and last winter each company camp was a long distance station. There was one exception to this as one of our lines only went to the St. Jovite office and did not connect with the "Bell."

The Cost of Construction

We have found the cost of building a two-wire or metallic line to average about $90 per mile where we have been able to support the line from trees. If however it is along a road in open country and it is necessary to erect poles the cost is materially increased. For this style of line we use a No. 12 B.W.G. galvanized iron wire which comes in half-mile coils and weighs 165 pounds to the mile. Oak side brackets and glass insulators to the number of thirty or forty per mile are used for support.

A much less expensive line, both in first cost and maintenance, is the one-wire or ground return system. This can be built for about $55 per mile and for it a No. 9 B.W.G. wire, in half-mile rolls, which weighs 305 pounds per mile, is used. To support this line we use a No. 18 7-strand soft seizing wire which holds a split ring insulator (Thomas No. 22) through which the wire passes. As this insulator only supports the wire and does not prevent a longitudinal slip it is necessary to use an oak bracket and glass insulator several times in each mile. The wire is actually held by the seizing strand to this glass insulator.

After experiment with a number of telephone sets we decided upon the Northern Electric No. 1317P set and with this we used the No. 60-B protector manufactured by the same company. In one case where several hundred feet of wire was destroyed by heavy electric currents from lightning striking the line, this protector arrested the current before it could damage our telephone set. I do not think that anything more need be said as to the advantages of this protector. The cost of a telephone set with the material for its installation is about fifteen or sixteen dollars.

Our costs of construction have divided themselves up about as follows:—

Materials	22 per cent.
Labour	45 per cent.
Provisions	23 per cent.
Teaming	10 per cent.

Fire Prevention Saves Construction Cost

The whole amount expended on our lines might easily be saved, and I feel sure it has been, by getting men to one fire in time to place it under control. As a matter of fact, this last summer, when fires and fire danger were at their height, the telephones proved their value over and over again, by enabling us to send assistance to a ranger in the shortest possible time. The rangers all carry small portable sets and they are able to connect this to the line at any point. Except in the back parts of the limit, it is seldom that a ranger is over five miles in a direct line from the wire.

Outdoor Sub-stations and Equipments

Coming to be Recognized as Standard Practice—Some Interesting Details Concerning Their Advantages and Construction Costs

By Mr. H. W. Young*

The outdoor sub-station, together with weather-proof switching, fusing and protective equipment, now occupies a very definite place in high tension distribution. The purpose of this paper is to bring before your organization some of the outdoor installations which have come under the author's observation during the past few years, and at the same time discuss the entire subject in a general way.

Field of Outdoor Sub-Stations

The ability to supply large, sparsely settled areas with adequate electric service is largely dependent upon the possibility of installing comparatively small capacity outdoor sub-stations. In many cases the total transformer capacity may be as low as 50 kw., and in the large majority of installations the capacity is less than 150 kw. With these relatively small loads it would be impossible, from an economic standpoint, to construct indoor type sub-stations and employ the form of equipment considered necessary a few years ago.

The logical method of serving these scattered consumers, small communities, etc., is to employ high tension transmission feeders, tapping them at various points by means of the modern low-cost outdoor sub-station. There is no necessity of dwelling on the inevitable superseding of many small generating plants by a few large generating stations from which will radiate high tension feeders, as this is no longer a theory or probability—but is now standard practice. Broadly, it is not a question of whether outdoor high tension equipment will be used, but rather how much does it cost, is it practical and how much equipment can be advantageously used in a given territory?

The Use of Standard Equipment

When possible it is advisable to use standard or "ready-made" sub-stations, rather than special designs. The prime object in distributing high tension power is to make a profit for the central station. Time is money, and it costs to call in operating engineers to design stations, incur drafting room expense, consume the time of department heads, etc. When it is decided to supply a consumer from the high tension lines, try to use a standard station, as there is a type for practically every service.

The standardization of steel tower outdoor sub-stations by the manufacturer is of real importance to the user, as it eliminates the chance of error—always present when such equipment is designed by local men to whom it is special or unusual work.

Use of Galvanized Equipment

It is now quite generally recognized that all steel and malleable iron parts should be hot galvanized if possible. This process insures equipment proof against rusting and guarantees a much longer life than it is possible to secure with plain black or painted material. Actual experience has demonstrated the difficulty of thoroughly painting every part of a high tension tower, and the unprotected surfaces will always rust—especially at points of contact or where angles cross. If painted equipment is used, it must be recoated at rather frequent intervals and in order to paint those parts near the top of a station, it becomes necessary to either discontinue service or endanger the men. A careful consideration of this problem from an operating standpoint has resulted in the general adoption of "hot galvanizing" as a standard—especially where comparatively light steel angle is used.

Line Voltage

As the transmission voltage of 33,000 is rapidly becoming a standard, this pressure has been selected in computing the costs shown in the tables and curves accompanying this paper. With a 33,000 volt transmission, a large territory can be economically covered, the equipment is standard, is made in large quantities, is reasonable in cost and can be promptly delivered by the manufacturers.

For the large majority of installations, the local distribution can best be accomplished by a 3-phase delta connected 2,200 volt system which has several advantages, such as permitting the use of standard 2,200 volt transformer at consumer's premises, freedom from short circuits in case of ground on one phase, etc. Again, in many cases, it will be found advisable to operate small power loads with two transformers connected in open delta, and for such installations the 2,200 volt delta distribution is advisable.

Line Costs

In making up estimates for the installations of outdoor sub-stations, the cost of building a high tension line to cover a given area must always be considered. The net cost per mile of transmission systems varies over a wide range, depending upon local conditions, type of construction employed, etc. The amount of money to be spent on such systems depends largely upon the requirements to be met and whether the work is to be regarded as temporary or permanent. In many instances the tendency has been to adopt rather light construction which cannot be regarded as meeting modern requirements, such as reliability, continuity of service, and permanent work.

The costs given in the accompanying table are based on northern cedar poles, Chicago delivery, and the average prices quoted during August, 1914. Line costs are more or less variable, depending upon market and labor conditions, but the figures given can be safely used for estimating purposes.

It will be noted that No. 10 copper-clad is specified for the telephone circuits, while many companies use No. 12 hard drawn copper. The No. 10 copper-clad is, however, stronger and will give better service than the smaller wire.

Attention is called to the fact that the prices given do not include any percentage for store-room charges, incidentals, etc. There is always some miscellaneous material necessary for transmission lines, the cost of which actually enters into the total cost of the line. It is, therefore, good practice to add five per cent. to the material to cover incidentals.

Outdoor Sub-Station Costs

When considering the use of outdoor sub-station equipment, one of the first questions is—how much will it cost? As a ready reference in making up preliminary cost estimates, the values given in tables 1, 2 and 3 can be safely used. These costs are based on normal prices quoted during August, 1914.

The data given in table No. 1 is graphically shown in Curves A, B and C, Fig. 1. The data given in table No. 2 is graphically shown in Curves D and E. A curve for table No. 3 would have the same general characteristics as Curves D and E. The rapid decrease in cost per kilowatt with in-

*President Delta Star Electric Company.

3-PHASE TRANSMISSION LINE COSTS—33,000 VOLTS

Using Galvanized "Bo-Arrow" Type Arms, Clamp Pins and Steel Telephone Brackets

SIZE OF LINE — APPROXIMATE NET COST PER MILE OF MATERIAL AND LABOR —

Conductors	Size of Poles	Poles and Cross Arms	Insulators and Pins	Ground Wire and Bayonets	Copper Wire	Telephone Line No. 10 Copper Cled	Labor and Supervision	TOTAL COST PER MILE OF LINE
No. 0	35′ 7″	42—35′ 7″ @ $8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$499.84	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. ⅜″ ground and guy wires @ $11.50 per M 48 Bayonets @ 57 ea. Total Cost=$94.06	5400 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$876.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags (½″x6″) @ .03½ ea Total Cost=$62.32	Labor, teaming Supervision $450.00	Poles and arms . . . $499.84 Insulators and pins ... 93.90 Ground wire & bayonets. 94.06 Conductors and ties.... 876.00 Telephone Line .... 62.32 Labor and Superv. .... 450.00 Total Cost $2076.12
No. 2	35′ 7″	42—35′ 7″ @ $8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$499.84	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. ⅜″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	3500 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$572.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags (½″x6″ @ .03½ ea. Total Cost=$62.32	Labor, teaming Supervision $425.00	Poles and arms... $499.84 Insulators and pins ... 93.90 Ground wire & bayonets. 94.06 Conductors and ties.... 572.00 Telephone Line........ 62.32 Labor and Superv 425.00 $1747.12
No. 0	30′ 7″	36—30′ 7″ @ $5.50 ea. 6—35′ 7″ @ 8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$384.64	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. ⅜″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	5400 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$876.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags (½″x6″ @ .03½ ea. Total Cost=$62.32	Labor, teaming Supervision $425.00	Poles and arms....... $384.64 Insulators and pins..... 93.90 Ground wire & bayonets. 94.06 Conductors and ties.... 876.00 Telephone Line........ 62.32 Labor and Superv...... 425.00 $1935.92
No. 2	30′ 7″	36—30′ 7″ @ $5.50 ea. 6—35′ 7″ @ 8.70 ea. 4—40′ 7″ @ 11.00 ea. 2—45′ 7″ @ 13.30 ea. 48—Arms @ 1.33 ea. Total Cost=$384.64	150 Insulators @ $.45 ea. 48 (set of 3) clamp pins @ $.55 ea. Total Cost=$93.90	5800 ft. ⅜″ ground and guy wires @ $11.50 per M 48 Bayonets @ .57 ea. Total Cost=$94.06	3500 lbs. @ $.16 lb. 75 lbs. No. 4 tie @ $.16 lb. Total Cost=$572.00	320 lbs. @ $.15½ lb. 48 brackets .10½ ea. 96 insulators @ $.04½ ea. 96 lags(½″x6″)@.03½ ea. Total Cost=$62.32	Labor, teaming Supervision $400.00	Poles and arms....... $384.64 Insulators and pins..... 93.90 Ground wire & bayonets. 94.06 Conductors and ties.... 572.00 Telephone Line........ 62.32 Labor and Superv...... 400.00 $1606.92

creased capacity of station is worthy of note. This indicates that the original installation should be such that as the load increases the station capacity can be increased at the least possible expense. With the standard control and protective equipment now available it is only necessary to replace the original fuses with others of heavier rating, when increasing the station capacity.

Net Cost. Table No. 1

Net Cost per KW. of Outdoor 3-Phase Sub-Station Equipment

Station Capacity	No. of Trans.	Transformer cost per KW 25 Cycles	Transformer cost per KW 60 Cycles	Cost per KW of High Tension Switching and Protective Units
45	3-15 kw.	$25.00	$20.00	$6.25
60	3-20 kw.	20.50	16.50	4.75
75	3-25 kw.	18.00	15.00	3.80
90	3-30 kw.	16.00	13.00	3.10
120	3-40 kw.	12.50	10.50	2.50
150	3-50 kw.	11.00	9.00	2.00

Net Cost. Table No. 2

Total Net Cost of Steel Tower 3-Phase Outdoor Sub-Station

(With 3 single phase 33,000/2,300 volt transformers)

Station Capacity	No. of Trans.	25 Cycle Station Per KW	Total Cost	60 Cycle Station Per KW	Total Cost
45	3-15 kw.	$35.00	$1,597	$30.25	$1,361
60	3-20 kw.	28.50	1,710	24.50	1,470
75	3-25 kw.	24.50	1,837	21.50	1,612
90	3-30 kw.	21.50	1,935	18.25	1,642
120	3-40 kw.	16.75	2,010	14.50	1,740
150	3-50 kw.	14.25	2,137	12.00	1,800

Net costs in Table No. 2 include all high tension bus bar supports, copper tube bus, high and low tension dead ends and a galvanized steel tower with footings.

Net Cost. Table No. 3

Total Net Cost of Wooden Pole 3-Phase Outdoor Sub-Station

(With 3 single phase 33,000/2,300 volt transformers)

Station Capacity	No. of Trans.	25 Cycle Station Per KW	Total Cost	60 Cycle Station Per KW	Total Cost
45	3-15 kw.	$34.25	$1,541	$29.35	$1,321
60	3-20 kw.	27.00	1,656	23.55	1,415
75	3-25 kw.	23.60	1,774	20.65	1,550
90	3-30 kw.	20.60	1,854	17.65	1,589
120	3-40 kw.	16.20	1,944	13.80	1,656
150	3-50 kw.	13.95	2,092	11.90	1,785

The costs in Table No. 3 are based on the use of 4, 35 ft. 8 in. top poles.

Open Delta Installation

When the original transformer installation consists of two units connected in open delta, the station capacity can be readily increased by adding a third unit of the same type and connecting in closed delta. Where three transformers were originally used, they can be removed and transformers of greater capacity installed—care being taken in the original installation to see that means are provided for readily removing and installing transformers.

Location of Transformers

Central station managers contemplating the use of outdoor sub-stations frequently request information as to whether the transformers should be located on or near the ground or at a point higher up. This question can be answered in several ways, as local conditions always govern. Fundamentally, the placing of transformers on platforms any considerable distance from the ground involves additional expense, especially for large size units. The sub-station supporting frames or towers must be heavier than if the transformers were on the ground, and in case of burn-out it is more difficult to remove or replace a damaged unit.

However, by mounting transformers on a platform approximately 12 feet from the ground, certain advantages are

gained. The high tension wiring can be kept up out of the way, fewer high tension bus supports are required and the general factor of safety is materially greater than with wiring near the ground. Another advantage secured by a platform mounting of approximately 12 feet, is that it gives sufficient space for a housing at the base of the sub-station. In this house can be placed all the secondary switches, meters, relays, street lighting regulators, spare parts, etc., thus securing a self-contained sub-station.

In general, it will be found advantageous to place large transformers on or near the ground and mount transformers of 50 kw. or less on a platform 10 to 12 feet above the ground.

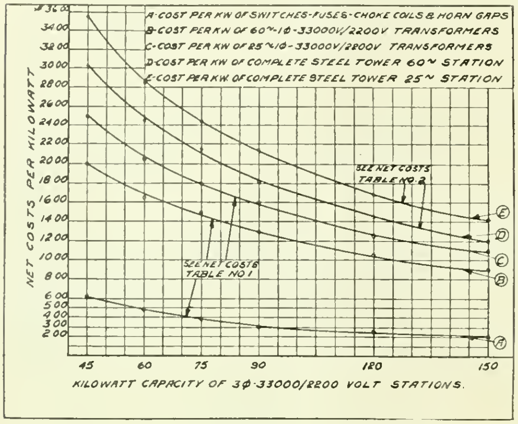


Fig. 1.—Curves showing the results given in above tables.

Provision can be readily made for conveniently and rapidly handling transformers so that in case of failure a defective unit may be quickly removed and replaced.

High Tension Fuses

Short circuits on high voltage systems have always ranked among the most potent of trouble makers. If the line is not cleared quickly and completely, serious trouble and destruction may follow. Often the voltage of the entire system will be pulled down, or under severe short circuit conditions the generators, transformers or other apparatus seriously damaged. Again, if short circuits on high tension feeder lines are not cleared quickly the station automatic switches will be operated and the entire main line shut down. For use in connection with relatively small ampere capacity loads, say 50 amperes or less at 33,000 volts, the automatic oil circuit breaker is handicapped, due to its high initial and installation costs.

The practical method of interrupting these high voltage low capacity circuits is by means of fuses which will clear the circuits just as, or even more, quickly than the expensive oil circuit breakers. One of the most successful types developed is the chemical form, consisting of a short fuse wire under tension and hermetically sealed in a glass tube filled with a carbon tetrachloride solution. This form of fuse has the desired characteristics of quick action, minimum disturbance to the system, positive indication whether open or closed, and ready replacement. Aside from exhaustive laboratory tests, this fuse has been in successful commercial operation a sufficient length of time to thoroughly demonstrate its characteristics. Many short circuits have occurred on high capacity systems, and in every instance the fuse has cleared the lines without danger to either the feeders or generating installations.

Continuity of Service

Continuity of service as applied to the general distribution system should be maintained at the highest possible standard. An occasional interruption of service to an isolated group of consumers cannot be construed as a criticism of the general service. General interruptions would, however, be very undesirable, and precautions should be taken to prevent them. A too common cause of interruption on high tension systems is due to the failure of insulation; in other words, the line insulators are often too light to meet those abnormal conditions which occasionally arise. The use of liberally designed insulators on the lines, the installation of electrolytic arresters at generating stations or important distribution points, and the frequent installation of air break sectionalizing switches, will materially aid in decreasing interruption to main lines or feeders.

Localization of a disturbance is important, and with the equipment properly installed there is but slight chance of communication to the main system.

The Proper Course For The Engineer

A Classical Scientific vs. a Purely Technical Education—The Victories of Peace and Magnificent Achievements in Industry

By Mr. Arthur J. Rowland*

The idea of a technical course for engineers is relatively new. Like most new things it has had to prove its merit in order to secure proper recognition. It received little sympathy in its beginnings, and even today, when education for definite vocations has won its long battle, many of the older men are apt to think that what was good enough for them ought to be good enough for any one. The headway made by the technical course in recent years shows that it is here to stay; it has definite merit and a definite place in education. I do not undertake to say that the old-fashioned "arts course" has no merit or that it may not form a good foundation for an engineering course in cases where a man has time to pursue both branches of learning. One problem only is considered in this paper. Is the classical-scientific or the technical course the better for the engineering student? The subjects included in a technical course are those immediately connected with the application or expression of science.

Successful Courses Must Have Proper Character

A very important consideration when weighing the relative merits of the classical-scientific vs. the technical course is that which takes into account the elements which make for success.

The act of entering an engineering course and following it, is a purely voluntary act on the part of anyone. A sufficient incentive must then be found to draw students and hold them after they have started. If a course is to be successful, two things are paramount in securing the necessary results: the interest taken in the course, and the value of the reward which is to be secured on graduation.

The attitude of most people, especially in a country like our own, where there is no distinction of class or caste and

* Read before the A. I. E. E.

where many very humble homes are represented by students in college courses, is to question the value of all the subjects of instruction included in them. A man in one of our elementary evening classes asked, "Why should I go through all this here mathematics to learn a little about motors?" (He was getting decimals, percentage, and simple proportion). A father discussing a college not a thousand miles away where his son was at work, said to me, "It's a place where French and ancient literature form the bulk of the engineering course."

Interest is the element which can be best counted on to make a course successful. The interest of students who really care is held when they are doing the real things of applied science or are studying subjects which manifestly have some bearing on the career they had in mind when entering an institution. The interest taken by the general public in a particular engineering course is often set by the reputation in consulting or research work gained by a man at its head; or by the way in which he is able to keep in the public eye. Even though such a man has no ability as a teacher and habitually neglects his students, his course may be extremely successful for a while at least, merely because of the interest in the man which has been established with the public. But in the long run, it is the way in which engineering knowledge secured in a course of study fits the needs of the community, which counts the most. Every day people in the world are coming more and more to recognize that pure science has its relation to the real interests of the community only in so far as it supports and clarifies the applied science, which is the great community servant. The Cincinnati experiment in co-operative engineering has proved successful mainly on account of the recognition by the community of the value of the professional training given in it. It is surprising to see at how early an age the modern youth takes a definite, practical view of life. It may even be as far back as the first or second year of high school work.

The other incentive which causes men to hold on to the end of a course and graduate is the reward to be secured. This reward may take the form of the diploma or degree which is won; the kind of position which may be secured as the result of the efforts of many and well-organized alumni; the graduate's future standing in the world, gained as the result of the reputation of the institution with which he has been connected. Such rewards are to be given their due weight. A man's future may be influenced as much by them as by any real knowledge he possesses. Such rewards may even make a course apparently successful in which the students really take no interest at all. And yet the best reward is certain to be the self-consciousness that as a graduate a man is trained to think and to work intelligently and efficiently. He is only so trained when he has within his command the tools of his profession along with a thorough knowledge of its principles.

Existing Engineering Courses All Have Some Special Characteristics

A large number of the existing engineering courses have been planned on the basis of certain State-established entrance requirements, using curricula developed from the old "arts" courses. They are arranged so that no engineering subject can be reached until calculus is finished, and since this is rarely earlier than the end of the sophomore year, the first part of the course is filled with general education subjects. People who are highly educated in general subjects, who are learned as the result of long culture environment, who know the art of fine writing, and the delights of poetry, approve such courses. Those who know nothing of engineering but have fixed ideas as to what constitutes college education are ready to help to frame them. But what do they mean to the boy who, with his heart set on engineering, never could make anything of the philological side of language or history? He falls out of the running before ever he gets a chance for even a taste of it.

There have been many places where the personal ideas of those who conduct engineering courses have been quite unable to influence very strongly the character of the work offered. Tradition and precedent count for too much. The engineering director of a course in such a place, who has originality and understands the importance of practical training, eventually succumbs to the inevitable.

That something is wrong in the characteristics of many engineering courses is pretty well shown by the lack of fundamental knowledge shown by college graduates who have been given places in the large electric manufacturing companies of the country. Some years ago a book of questions and answers was printed and offered for sale by a couple of men connected with one of these big companies to help student apprentices to required knowledge. I looked over a copy and eventually wrote the authors to ask whether it was possible that graduates in engineering really were ignorant of the answers to most of the questions. The reply I received seemed to indicate it was so; a clear indication, I had to conclude, that practical training was sadly lacking in the courses they had followed.

Are Purely Technical Courses Really Successful?

Classical-scientific education leads to conditions like those encountered in the engineering department of a large corporation I visited some months ago. The chief engineer (himself a college man), in reply to a question, said, "I would rather have a man from the tool room in the designing work than any college man." After pointing out a number of men in the room from prominent colleges and universities, he said further, "All they know is how to design a beam to support a fixed load a given number of feet beyond a wall, or other purely textbook problems. How the beam is to be held in the wall, or the load suspended from it, is beyond them." It is a long slow process to train men who have never taken the steps passing from pure to applied science, to take hold of real live problems of the engineering world. They have the principles, perhaps, but do not know how to apply them. In the technical course the very same principles are presented, but would be coupled with applications such that the student comes to feel that they all have a vital, direct relation to practical affairs. The test of knowledge is the ability to think clearly on a new problem, rather than to search the filing cabinet of the brain for the data which show that the new problem is simply a variation of some old one.

In the classical-scientific course, research men may be developed; but too often such men are sadly lacking in the ability to handle practical problems, because of a narrowness of vision. Of course we must recognize, on the other hand, that in such courses, as in those of other non-engineering types, education, no matter in what direction, has a value of its own which all know and appreciate. Association with educated people, living in an environment of cultivation and learning, must produce an uplift, a broadening of view, which is fine to gain. There may be many men taking engineering courses who delight in language study as an art, in the broad reaches of modern and classic literature, and in the theories of pure science; but in this paper I am keeping in mind the man who is an engineer because he is destined to it, whose whole fiber is bound up with thoughts of design and construction. Such a man does not take such a course because he picked it by chance; or because he thought it might prove as interesting as any other. He takes it because there is no other which seems to him half so attractive, half so worth while.

The cultural value of certain kinds of studies is common-

ly urged when championing a classical-scientific course. Now culture is "to know the best that has been said and thought in the world." "The training, development, or strengthening of the powers, mental or physical, or the condition thus produced; improvement or refinement of mind, morals, or tastes; enlightenment or civilization." "Act of improving or developing by education, discipline, etc.; the training, disciplining, or refining of the moral and intellectual nature." On such bases there is as much culture to be found in technical subjects as in any other sort. Is the mind any less cultured which can appreciate a fine piece of reasoning and the direct engineering application, than the one which can appreciate a fine piece of music? Is the technical investigation of transformer theory any less cultural than the reasoning ability developed by logic or ethics? Are we not badly hampered in securing a clear feeling about such matters because of what we have been taught and the precedent of many years of established ideas? The sense in which the term culture is often used seems to indicate that a person who is cultured is for that reason able to shine in society; to talk well with strangers on subjects they know. It seems a pity that people generally cannot better appreciate scientific and engineering subjects. It is a pity if an engineer when he is in "society" must drop all reference to the subjects which command his interest in his daily life.

If securing culture includes gaining a first-rate mental development, I may suggest that, as too often taught, subjects like language and history and even some kinds of science and mathematics are memorizing subjects. It requires no special mental development to gain purely informational knowledge. Scientific and engineering subjects must be thought through and understood. There is no higher culture than the ability to think clearly and well. One who can do this should also be able to express himself clearly and well. I have wondered sometimes whether the so-called culture subjects of some engineering courses were not included as fillers, because to teach them only a class room and a teacher are required and they are relatively inexpensive. Certainly a type of mind typical of the highest type of manhood can be acquired quite as easily through studying technical subjects as through studying Chaucer and medieval German.

Technical Courses Have Some Very Distinct Merits

The man whose life work is applied science sees and appreciates the direct application of everything he gets. The Cincinnati co-operative scheme in engineering education is a first-class illustration of this. The difference between the gain of a student whose alert and active interest is held by conscious applications as he reads his text or participates in class discussions, and that secured by the student who blindly grasps at principles and laws in an abstract way, is startling to one who has seen the difference. In our own engineering work the professor of chemistry has recently diverged from the old beaten path of general chemistry, qualitative analysis, etc., to engineering chemistry (really a much harder study). The difference in the class and its attitude toward the work were remarkable. The active interest, the feeling that they were now learning something worth while, were typical of the difference referred to above. The student in the technical course knows that he is being equipped with the tools of his profession. He feels that every hour of work takes him toward the goal he wants to reach. The teacher can count on the interest and attention of his class to such an extent that he may find them impatient at the speed he thinks it safe to make.

The whole trend of modern education is to train for usefulness. Relatively few are so well favored that it is possible for them to consider higher education merely as a wholesome broadening influence in their lives. Besides this, the immense field of knowledge which is included in engineering nowadays leads to the conclusion that if a reasonable idea of fundamental principles and a little of their application are secured within the length of time most people can afford to give to college, no subjects except those which are technical can be included.

Of the cultural side of a technical course much could be said. While studying engineering, the student gets in an incidental semi-conscious way a knowledge of the victories of peace, and of the magnificent achievements in industry. Such things are certainly of much more real value and more worth knowing about than the trend of things in the world as studied from the standpoint of conquest and war. For there are heroes of engineering today. We find them in the men who are really doing things for their fellow men, making the sum of human happiness steadily greater. More and more we are coming to realize that the men who are bent upon destroying their fellow men and blocking real progress in the world by war or political intrigue are not the heroes for our youth to emulate.

The Technical Engineering Course Should Reach Back of College Work

It is but a short space of time since practical subjects taken in the period of school work preceding college entrance began to be counted in securing credits for entrance. Today they are too often discredited, both with reference to entrance and in securing recognition or credit in connection with freshman work. Standard college entrance requirements have forced high and college preparatory schools to a definite kind of training which in many cases does not admit of any engineering subject being studied even in an elementary way, until the college course has been begun. Many and many a parent looking forward from the grammar school period of education, anxious to have the boy trained for some sort of engineering pursuit, gives up the whole thing as hopeless when he finds that six years must pass (four of high school and two of college) before any real engineering subject is touched. There are very many boys between fourteen and sixteen years of age who leave school early in a high school course when they find there is no hope of securing training there in anything they consider practical, anything directly connected with industrial pursuits, wherein they hope eventually to secure their livelihood, their opportunities, and their advancement in life.

Manual training schools have to some extent tried to meet this difficulty, although originally devised purely for general education purposes to train the hand along with the mind and produce an education of the whole man. But they have often gone wrong, and the relation of their work, or rather a lack of relation, to the electrical industries is shown when it is found that, for example, in a large and successful one not far away, students are graduated without ever touching a circuit through which dynamo current flows, or looking through a telescope at the mirror of a reflecting galvanometer.

Conclusion

I believe heartily and sincerely in the technical course for engineering students. Whatever the advantages of others, it is my belief that none equals it in yielding rich incentive to scholarship, life interest in one's daily work, and definite hope of rewards to be gained. But I also believe that a far greater need could be met were it possible to start engineering education early in the high school period and distribute the general education subjects commonly found in that period, all the way along to the time of graduation from college.

"Going After" Business the Only Way to Get It

The Present is No Time to Rest on One's Oars—Business Lost Now will be Hard to Regain—New Customers Gained Now will be Doubly Valuable When Trade Revives

By Mr. A. A. Briggs

[Editorial note—In view of the fact that the Dunlop Tire & Rubber Goods Company, Limited, have decided to increase their advertising appropriation at the present time, this summary of conditions which influence national advertisers in making such a decision, will undoubtedly be read with great interest.]

Retrench—"To lessen, to abridge, to curtail"—that's what the dictionary especially calls it.

But hasn't the war so far shown that to retrench means particularly to **dig out a fresh trench**, to secure the means and the assistance to make a new assault on the enemy? In the latter interpretation we undoubtedly find what ought to be the keynote for the present advertising situation in Canada.

The truth is that on one side of the Dominion are ranged people who are following the dictionary's main stipulation of "retrench" for their publicity guidance. They may have reasons for so doing which no one in a different line of production can justly pass an opinion on; but it is also true that on the other side are ranged people who are leading—not following anything or anybody in their advertising policy which does not at once spell **Action**. It cannot be denied that the people who have decided "to lessen, to abridge, to curtail" their publicity are in the ascendancy at the present time. And everywhere the reason advanced is: "The War."

So far, from the standpoint of salesmanship, **no one has adduced a solitary economic reason why Canadian manufacturers who inaugurate advertising campaigns as a regular portion of their selling effort should discontinue that programme at the present time.** And, is it not strange that in all our mental hurrying to and fro, no one has yet proclaimed the fact that the war did not alter the Canadian consumer-purchasing market one iota? It must be understood that in making the above statement we are not dealing with any isolated cases where this particular business or that particular business may have been affected in countless ways other than the selling end. It is true, a manufacturer may have to pay more for his raw materials as one result of the war, but if he can get the materials at all, he always has the instrument of retail price-increase to wield in offsetting his losses, if necessary.

What really did alter the possibilities of the consumer purchasing field in Canada? Not the war, but the lull that antedated the war. A number of reasons precipitated the lull—most of which the public are conversant with. In other words; dull times, if one chooses to call them such, were here anyway—here in the sense that while the consumer was willing to a considerable extent to make purchases, the middleman had in many cases gone rather askew in his financing. The war simply accentuated the fast-spreading inclination to sit tight.

Naturally, during a portion of 1913 and most of 1914, manufacturers, in the main, were conservative in the matter of building extensions and such like, and sales efforts were always linked to due caution. This year, probably more than usual, attention was centred on the outcome of the Western wheat crop. That crop virtually has arrived, and, if reports are true, it is a good deal larger than advance estimates intimated. Then, notice the price per bushel paid for some wheat at the elevators. The farmers should now assist basic money circulation, which, of course, always commences the upward trend in the retail line.

In seeking out forces for advertising stimulus, it is one thing to deal with the possibilities of new fields of endeavor for Canadian manufacturers and another thing to explain away the measure of uncertainties attached to them. It cannot be gainsayed that consideration of new fields may mean consideration of bonuses and tariffs. What ought to be emphasized is that the Canadian manufacturer has, at least, as much area market as he had previous to the war and the general lull in consumer-buying conditions. Therefore, instead of risking new fields, which at best may be a costly experiment, the natural course seems to be that of again seeking the old field—**but seeking it ten times more forcibly.** This fact is brought home to us with double force when we have evidence aplenty that our friends to the South, in the widespread revival of the export propaganda, are considering the commercial blanketing in this country. It, therefore, behooves the Canadian manufacturer who has advertised in the past, not only to advertise again to create consumer demand for his wares, but to advertise as a means of actually holding what he already has. While suggestions are being made to flank some of the European countries' export business to Canada, we should not allow ourselves to be flanked in a commercial sense by our neighbors across the line.

Those advertising men who passed through the trade siege of 1907 and others before it—which sieges or lulls, or whatever you wish to call them, some bankers say cast their sly glances our way approximately every seven years—know well that **the manufacturers who assumed the defensive in publicity matters on those occasions had a difficult time regaining their stride when normal times returned.** That is natural law in the commercial world. There is no profit in manufacturing, no excuse for a factory's existence, unless the selling end is vigorous. The energy which keeps the selling end vigorous in abnormal times is identically the same energy which keeps it vigorous in normal times—only it is in abnormal times that keeping up the stride is fraught with more discouragements. One hundred courageous manufacturers and five hundred patriotic purchasing agents are worth more to Canada at the present moment than a million sermons or editorials on humaneness in war.

Realizing that one of the big sticks in the commencement of Canada's Comeback is to be wielded by the purchasing agent, every man occupying such a position in Canada, should have a creed something to this effect hung over his desk where he who runs in for an order may read:—

"I have hitched the firm's wagon to the Made-in-Canada star.

"I will specify on all purchases that Canadian ma-

*Advertising Manager Dunlop Tire & Rubber Goods Co., Limited.

terials must be used or the order will be subject to cancellation.

"I know in so doing that I will thereby be encouraging the other fellow—whose traveller calls on me—to buy my firm's goods and possibly at a higher price, too, than he would have to pay for the foreign article."

Let us be assured that Canadian purchasing agents as a body have lined up behind the Made-in-Canada slogan, and we can expect to see Canadian advertising manufacturers assume the offensive. They will know that if they can secure a portion of the trade which formerly went out of the country, they can afford to write off certain business, the loss of which was consequent on a measure of consumer retrenchment. And let consumers see with their own eyes manufacturers' copy running in the papers and those self-same consumers—assured that the factory in which they are employed is going to keep running or the copy wouldn't be running—will commence again to make purchases with some measure of freedom.

Canadian manufacturers as a body must of necessity exist on Canadian orders; to the great majority "export" is an unused word. Orders will not be secured in dull times by methods that would fail in good times. One of the established beliefs of merchandizing is that properly-placed and properly-managed advertising is a force for facilitating sales. If this were not true, why would certain manufacturers—sixty per cent. of whose output might be styled luxuries—increase rather than decrease their advertising at this very moment?

They realize they have a big job on hand—that of securing orders when orders are unusually hard to secure. And they know full well that following the simple instinct of going after business is the only solution to the problem.

More Standardization Rules

The American Institute of Electrical Engineers has adopted, subject to editorial revision, a number of definitions and rules called "standardization rules." This is the outcome of a large amount of work which has been proceeding since 1898 as the result of the appointment at that time of a Committee on Standardization, the personnel of which has been changed and enlarged from time to time as requirements appeared to demand. The standardization rules include 567 topics. A large number of these are definitions which have reference to subjects of almost daily interest to electrical engineers and operating men. We are reproducing a number of these herewith in addition to others which appeared in our issue of September 15. In these standardized definitions it is to be understood that those about which there can be no misunderstanding are, for the most part, omitted.

A Double-Current Generator supplies both direct and alternating currents from the same armature-winding.

A Converter is a machine employing mechanical rotation in changing electrical energy from one form into another. A converter may belong to either of several types, as follows:

A Direct-Current Converter converts from a direct current to a direct current, usually with a change of voltage. Such a machine may be either a motor-generator or a dynamotor.

A Synchronous Converter (also called a rotary converter) converts from an alternating to a direct current, or vice-versa. It is a synchronous machine with a single closed-coil armature.

A Cascade Converter, also called a motor converter, is a combination of an induction motor with a synchronous converter, the secondary circuit of the former feeding directly into the armature of the latter; i.e., it is a synchronous converter concatenated with an induction motor.

A Frequency Converter converts the power of an alternating-current system from one frequency to another, with or without a change in the number of phases, or in the voltage.

A Rotary Phase-Converter converts from an alternating-current system of one or more phases to an alternating-current system of a different number of phases, but of the same frequency.

A Phase-Modifier, also called a phase-advancer, is a machine which supplies reactive volt-amperes to the machine; e.g., induction motor, or to the system to which it is connected. Phase modifiers may be either synchronous or asynchronous.

A Synchronous Phase-Modifier, sometimes called a synchronous condenser, is a synchronous motor, running either idle or with load, the field excitation of which may be varied so as to modify the power-factor of the system, or through such modification to influence the load voltage. The function of a Synchronous Phase-Modifier is to supply reactive volt-amperes to the system with which it is connected.

Direct-Current Commutating Machines comprise a magnetic field of constant polarity, an armature, and a multi-segmental commutator connected therewith. These include: direct-current generators; direct-current motors; direct-current boosters; direct-current motor-generators and dynamotors; direct-current compensators or balancers; and arc machines.

Alternating-Current Commutating Machines comprise a magnetic field of alternating polarity, an armature, and multi-segmental commutator connected therewith.

Synchronous Commutating Machines include synchronous converters, cascade-converters, and double-current generators.

Synchronous Machines comprise a constant magnetic field and an armature receiving or delivering alternating-currents in synchronism with the motion of the machine; i.e., having a frequency strictly proportional to the speed of the machine. They may be sub-divided as follows:

An Alternator is a synchronous alternating-current generator, either single-phase or polyphase.

A Polyphase Alternator is a polyphase synchronous alternating current generator.

An Inductor Alternator is a Synchronous Alternator in which both field and armature windings are stationary and in which masses of iron or inductors, by moving past the coils, alter the magnetic flux through them. It may be either single-phase or polyphase.

A Synchronous Motor is a machine structurally identical with a synchronous alternator, but operated as a motor.

An Induction Motor is an alternating-current motor, either single-phase or polyphase, comprising independent primary and secondary windings, one of which, usually the secondary, is on the rotating member. The secondary winding receives power from the primary by electromagnetic induction.

An Induction Generator is a machine structurally identical with an induction motor, but driven above synchronous speed as an alternating-current generator.

Unipolar or Acyclic Machines are direct-current machines, in which the voltage generated in the active conductors maintains the same direction with respect to those conductors.

Stationary Induction Apparatus changes electric energy

to electric energy through the medium of magnetic energy without mechanical motion. It comprises several forms, distinguished as follows:

Transformers, in which the primary and secondary windings are ordinarily insulated one from another.

The terms **"high-voltage"** and **"low-voltage"** are used to distinguish the winding having the greater from that having the lesser number of turns. The terms **"primary"** and **"secondary"** serve to distinguish the windings in regard to energy flow, the primary being that which receives the energy from the supply circuit, and the secondary that which receives the energy by induction from the primary.

The **rated current of a constant-potential transformer** is that secondary current which, multiplied by the rated-load secondary voltage, gives the kv.a. rated output. That is, a transformer of given kv.a. rating must be capable of delivering the rated output at rated secondary voltage, while the primary impressed voltage is increased to whatever value is necessary to give rated secondary voltage.

The rated primary voltage of a constant-potential transformer is the rated secondary voltage multiplied by the turn ratio.

The **voltage ratio** of a transformer is the ratio of the r.m.s. primary terminal voltage to the r.m.s. secondary terminal voltage under specified conditions of load.

The **"current ratio"** of a current-transformer is the ratio of r.m.s primary current to r.m.s. secondary current under specified conditions of load.

The ratio of a transformer, unless otherwise specified, shall be the ratio of the number of turns in the high-voltage winding to that in the low-voltage winding; i.e., the "turn-ratio."

The **"marked ratio"** of an instrument transformer is the ratio which the apparatus is designed to possess under average conditions of use. When a precise ratio is required, it is necessary to specify the voltage, frequency, load and power factor of the load.

Auto-transformers have a part of their turns common to both primary and secondary circuits.

Voltage Regulators have turns in shunt and turns in series with the circuit, so arranged that the voltage ratio of the transformation or the phase relation between the circuit-voltages is variable at will. They are of the following three classes:

Contact Voltage Regulators, in which the number of turns in one or both of the coils is adjustable.

Induction Voltage Regulators, in which the relative positions of the primary and secondary coils are adjustable.

Magneto Voltage Regualtors, in which the direction of the magnetic flux with respect to the coils is adjustable.

Reactors or **Reactance-Coils,** also called Choke Coils; a form of stationary induction apparatus used to supply reactance or to produce phase displacement.

An Ammeter is a measuring instrument, indicating in amperes.

A Voltmeter is a measuring instrument, indicating in volts.

A Wattmeter is an instrument for measuring electrical power, indicating in watts.

Recording Ammeters, Voltmeters, Wattmeters, etc., are instruments which record graphically upon a time-chart the values of the quantities they measure.

A Watt-hour Meter is an instrument for registering watt-hours. This term is to be preferred to the term "integrating wattmeter."

A Line-Drop Voltmeter Compensator is a device in connection with a voltmeter, which causes the latter to indicate the voltage at some distant point of the circuit.

A Synchroscope, sometimes called Synchronoscope, is a device which, in addition to indicating synchronism, shows whether the machine to be synchronized is fast or slow.

A Generator is a machine which transforms mechanical power into electrical power.

A Motor transforms electrical power into mechanical power.

A Booster is a generator inserted in series in a circuit to change its voltage. It may be driven by an electric motor (in which case it is termed a motor-booster) or otherwise.

A Motor-Generator is a transforming device consisting of a motor mechanically coupled to one or more generators.

A Dynamotor is a transforming device combining both motor and generator action in one magnetic field, either with two armatures, or with one armature having two separate windings and independent commutators.

A Direct-Current Compensator or Balancer comprises two or more similar direct-current machines (usually with shunt or compound excitation) directly coupled to each other and connected in series across the outer conductors of a multiple-wire system of distribution, for the purpose of maintaining the potentials of the intermediate wires of the system, which are connected to the junction points between the machines.

A Reactor is a coil, winding or conductor commonly known as a reactance coil or choke coil, possessing inductance, the reactance of which is used for the operation, protection or control of a circuit or circuits.

The Efficiency of an electrical machine or apparatus is the ratio of its useful output to its total input.

Personals

Mr. Chalmers, public utilities commissioner of Edmonton since January, 1912, has resigned.

Mr. Robert Dakin has been appointed electric wiring inspector for the towns of Galt, Preston and Hespeler.

Hon. I. B. Lucas, provincial treasurer of the Ontario Government, has been appointed a member of the Hydro-electric Power Commission of Ontario, succeeding Col. Hendrie.

Lieut.-Col. Hon. J. S. Hendrie, member of the Hydro-electric Power Commission of Ontario since its creation some years ago, has been appointed Lieutenant-Governor of the Province of Ontario.

Mr. R. M. Milan, Saskatoon, has been appointed electrical superintendent of the Dominion Government interior storage elevator at Moose Jaw. Mr. Milan will have charge both of the installation and operation of the elevator.

Mr. R. F. Morkill, signal engineer of the Grand Trunk Railway, who contributed an article on "Automatic Signals on Victoria Bridge," to our issue of September 15, has left for the front. He is a lieutenant of the engineering corps. Mr. Morkill was engaged in the Boer war.

Mr. Joseph Townsley, well known in the Canadian telegraph field, is dead. Mr. Townsley superintended the building of the C. P. R. telegraph system east to Halifax and Kanso, and continued as superintendent of C. P. R. telegraphs until his retirement, on pension, in 1911.

Mr. Parker H. Kemble, formerly of Toronto Electric Light Company fame, has resigned his position as manager of the Electrical Commercial Department of the Union Gas and Electric Company, Cincinnati, on account of ill health. Mr. Kemble is said to be planning a house-boat trip with his family on the Ohio, Cumberland and Mississippi rivers.

Electric Railways

Financial Relations Between Cities and Utilities —By Bion J. Arnold, Chairman Board of Supervising Engineers, Chicago Traction

In a number of cities in this country arrangements of one sort and another have been made recently by which the municipalities share directly in the profits of the local electric railways and exert managerial influence in their operation. This movement is so vital in its nature and so far reaching in its consequences that each experiment must be studied carefully in order that its lessons may be well and promptly learned.

The partnership arrangement in Chicago has now been in operation for seven years, long enough for the determination of the wisdom of its provisions. It will be remembered that the city agreed with the railroad companies, as a condition preliminary to any settlement, that a valuation should be made and agreed upon which should be accepted as the initial price of the property. The difference between this amount and that of the outstanding securities was to be either sacrificed by the holders thereof or taken care of out of such net profits as the companies were allowed to make under the ordinances.

The railway companies saw fit to make this arrangement because almost every main franchise had expired, and operation was being conducted under temporary permits in the business districts of the city. One of the companies contended that it had a ninety-nine-year franchise under a certain ruling of the Illinois Supreme Court, but shortly after the settlement was made the United States Supreme Court ruled otherwise.

The valuation ultimately agreed upon was $50,000,000, the city allowing actually $11,000,000 more than the physical property was considered to be worth, partly because the legal decision mentioned above had not been handed down when the agreement was concluded and partly as the price of peace. Thus the $11,000,000 was in reality mainly allowed for unexpired ordinances and obsolete plants.

Rehabilitation of the property

The most important provision made in the arrangement was that for the rehabilitation of the property and the extension of the system under public supervision. The agreed purchase price to the city, which is practically the bonding limit of the companies, was to be increased by the amount of the expenditures made for these purposes, and the expenditures were to be authorized by a board consisting of three men, one representing the city, one the company, while the third was to be chosen by both. The last-named was to be independent of both interests and his name was to be written into the ordinance. During the past seven years under this arrangement the purchase price to the city has been increased to about $140,000,000 by the cost of the rehabilitation of the old property and by extension to it.

A second important provision of the contract provided for the acquisition of the railway property at any time by the city upon six months' notice, the price at any time to be the original $50,000,000, plus the amounts that had been added for rehabilitation work and extensions with the approval of the board. This will continue to increase by the method mentioned until in 1927, when the present twenty-year franchise expires. The amount will then be about $204,000,000.

A third provision is concerned with operation. The city granted a twenty-year franchise to the company, the maximum which could be granted under the state laws. The company operates the property, paying all operating expenses, including maintenance, insurance, taxes and a contribution to a renewal and damage fund, and receive five per cent. interest upon the agreed purchase price of $50,000,000 plus additions as above. The balance of the receipts is divided between the company and the city, 45 per cent. to the companies and 55 per cent. to the city. During seven years the companies have paid themselves 7 per cent. on their investment, including the above 5 per cent. interest, and have put about $14,000,000 in cash into the city treasury. By the end of twenty years I estimate that there will have been so deposited a fund, which if invested in suitable securities netting 5 per cent. income will, with accrued interest, amount to $90,000,000 at the end of the twenty-year period. The city can then buy for $114,000,000, which is $204,000,000 less this $90,000,000, a property having a tangible value of $150,000,000. In other words, this fund which the companies are putting into the city treasury is in reality an amortization fund, if it is allowed to accumulate properly, although it is not so called. It is thus seen that the price of the properties is automatically fixed and the machinery provided so that the city can acquire them at any time without dispute. When it is remembered that the present scheme was worked out after the municipality had endeavored to inaugurate municipal ownership, the wisdom of the present arrangement is obvious, as such ownership is automatically provided for whenever it is deemed necessary.

Intangible Assets

The question may be raised as to why there will not be a property worth $204,000,000 at the termination of the franchise. In the first place the new arrangement started with $11,000,000 in intangible assets. The railways of Chicago first operated horse cars, then cable equipment was substituted, next light electric cars were used and finally heavier electric cars became necessary. Thus not only was the sum of $11,000,000 paid for "junk" and franchises, as previously stated, but provision had to be made for the old cable system, obsolete cars, etc., which had to be eliminated and for 400 miles of track which had to be rehabilitated.

We made a mistake, some of us now believe, when the ordinance was passed in not providing that all or at least some of the profits should be used as an amortization fund for the purpose of retiring this intangible value. This will probably be rectified in the consolidation plan now being worked out under which it is proposed that the surface, elevated and subway lines will be operated as one system.

*In Electric Railway Journal.

The city of Cleveland made a solution of the tracttion problem quite different from the Chicago plan. Instead of an agreed purchase price a certain capitalization was agreed upon, and the company was allowed to earn 6 per cent. upon that capitalization and no more. This capitalization may be increased from time to time under the supervision of a city railway commissioner. The fare was also reduced to 3 cents with provision for increase under certain conditions. That is, there was incorporated in the franchise a clause providing some flexibility by stipulating that if a reserve fund of from $300,000 to $500,000, established by the terms of the ordinance, cannot be maintained with a 3-cent fare the fare can be increased or the income can be increased by means of a charge for transfers. Since the company has some outlying roads to which the 3 cent rate does not apply and the fact that cash passengers pay 5 cents unless they happen to have the exact change ready, the actual average fare now collected is 3.24 cents. At present the operation is experimental at this rate, and the rate may have to be raised still higher, and I understand that it has recently been decided to charge 1 cent for a transfer in addition to the initial fare. It is possible to operate on a low fare in Cleveland because the agreed capitalization is very low. The plan is, in my opinion, an experimental one. If it suceeds it should be remembered that the citizens of Cleveland are getting and will continue to get only such service as a 3-cent fare or a 3.24-cent fare or a 3-cent fare plus 1 cent for a transfer will yield. They will never get a 5-cent service for a 3-cent fare.

Best Solution So Far

The recently adopted Kansas City arrangement is a modified Chicago plan in which the "oversights" which I have mentioned have been eliminated. In Kansas City the railway was operating under a receivership. The citizens were rabid in their antagonism to the railway, as they believed that they had been misused. They felt that the system was overcapitalized, so much so that one of the leading papers of the city stated that the property was worth not more than $14,000,000, although, to be fair to it, this was before an actual valuation showed it to be worth much more. In fact, the company had vouchers to show that $35,000,000 had actually been spent upon the property. Under the settlement the company is to be allowed to earn 6 per cent. on $30,000,000, and all surplus above this is to be invested in an amortization fund to be used in gradually retiring the intangible value of the property. The tangible property, as shown by my valuation, is actually worth more than $21,000,000 to-day so that the amount to be amortized is about $14,000,000. This is a fundamentally sound proposition for, if the railway is finally acquired by the city, it will be purchased for what it is actually worth, or if the property is continued under private ownership and management, the rate of fare can be adjusted on a basis of paying a fair return on real value where the intangible value has been amortized.

In conclusion I would say that while I think that Kansas City has the best solution of the partnership arrangement so far worked out, the Chicago plan has worked very smoothly for seven years. Of course we have had differences of opinion in Chicago from time to time as to the wisdom of the board's judgment on one point or another, but these have thus far been easily adjusted. Chicago has watched with pride the growth of the city's fund, now amounting to about $14,000,000, and the citizens as a whole seem not displeased that the railways have earned 7 per cent. While I personally believe that the $14,000,000 fund should be used as an amortization fund so that in time, after the intangible value has been eliminated, the patron of the street car will not be paying a higher price than it costs to render the service he receives, nevertheless the Chicago arrangement taken as a whole can be considered sound and successful.

The Fight in Toledo

The electric railway situation in Toledo has taken another very interesting turn. It will be remembered that, following the expiration of the company's franchise, the City Council passed an ordinance fixing the regular fare at three cents. This amount the company refused to accept, claiming that the system could not be operated for less than a five cent fare. This deadlock has been maintained for several weeks, the conductors being instructed to collect the full five cent fare or nothing; in consequence, a large percentage of the citizens of Toledo, backed by the city ordinance, has been riding free. The matter was finally brought by the company before Federal Judge Killits, whose finding is that the city ordinance is unreasonable, unfair, and confiscatory. Judge Killits even goes so far as to declare that the original order was given with full knowledge that such a rate was not sufficient to even meet operating expenses, and that the city executive were "possessed of statistical information in most illuminating detail from the city's trusted expert, which, properly considered, showed that a three cent fare was confiscatory." The city solicitor stated that the original administration was fully apprised of the impracticability of the measure, and spoke of the political trickery that fathered it. As the matter now stands the city is enjoined from enforcing its ordinance for the three cent fare, which presumably leaves the way open for further franchise negotiations. In the meantime, the company have established the following schedule of rates: Cash fare, five cents; tickets good at all hours, six for twenty-five cents; tickets good only between 5.30 a.m. and 7.30 a.m., and between 4.30 p.m. and 6.30 p.m., five for fifteen cents or three cents each; children eight years old or under, one cent; children in arms, free. Apparently the citizens of Toledo are accepting the new rates as fair and reasonable.

Electric Railway Publicity

The Twin City Rapid Transit Company operating in and around the cities of St. Paul and Minneapolis is recognized all over Canada, both on and off the stock market, as one of the best constructed, maintained and managed electric railway systems in the world. For this reason the following brief article on its publicity system, reprinted from the Electric Railway Journal, will be read with particular interest:—

"The publicity work of the "Twin City Lines" is in the hands of A. W. Warnock, general passenger agent, who believes that "making the public your friend is a fine art, and like most arts, it is an extremely simply one, once you know how." Mr. Warnock's experience shows that friendly public sentiment can be developed through the giving out of accurate information on such subjects as "Why Present Rates of Fare Are Not Unreasonable," "How the Electric Railway System is Operated," etc. In reaching the general public the company has found the best mediums are the daily and weekly newspapers, window cards in the cars, folders and time-tables.

The company uses a great deal of advertising space in the local newspapers, utilizing such space liberally whenever there is any important announcement to be made, such as changes in schedules or any other matter which requires the co-operation of the public. In the news columns the company makes no attempt to play up new construction or development work, feeling that the papers are somewhat chary of printing matters of this sort. Mr. Warnock is, however, always ready to co-operate with the newspapers in getting up stories, and the company is on the friendliest relations with all of the local papers.

Windows cards in the cars are found to be very effective means for reaching the public. The endeavor is made in these to teach some lesson of importance in promoting effi-

cient transportation. Among the titles of these cards may be mentioned "Please Read Your Transfer," "Suggestion to Passengers," "For the Comfort of Passengers," "For Better Service," "Regarding Small Children," etc.

The "Twin City Lines," to an unusual extent, makes use of folders and time-tables, advertising particularly its steamboat line on Lake Minnetonka, the White Bear Lake Resorts, Minnesota State Prison, and points on the Stillwater line. In getting up this printed matter the underlying motive has been to produce something of a very high class, in the belief that cheap printed matter is not acceptable to the public and does not hit the mark. Handsome folders like one recently issued under the title, "The Twin Cities—1914," are highly prized by the public, and local publicity organizations of a civic nature are glad to send these out to people inquiring as to the merits of the "Twin Cities" as a permanent residence. The 1914 folder was the ninth annual publication. Of the folders just mentioned 52,000 copies were printed this year, and time-tables giving information regarding the Lake Minnetonka and Stillwater lines have been printed in editions of 35,000 to 50,000 copies each. A local company distributes these folders in all hotels, ticket offices and folder racks, and the steam railways use quantities for distribution to prospective tourists. For a period of five weeks at the beginning of the season the company advertised that this folder would be sent to any address on receipt of 6 cents in stamps. From this advertising an average of nearly a hundred inquiries a day were received from people who expressed an intention of spending a day, a week or longer in the twin cities. The steamships on the Great Lakes, from Buffalo to Duluth, are also supplied with these folders, and tourists destined for Minneapolis are given copies. The same holds true on the Mississippi River steamboats.

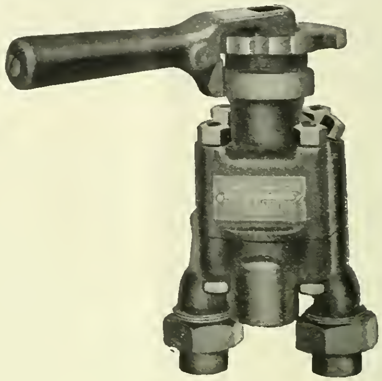
In reaching its own employees the company uses no regular publication, but prepares small bulletins occasionally which can be handed to the men with their pay checks. The bulletin boards posted in the clubrooms are also useful for this purpose.

To quote Mr. Warnock in a recently published statement: "I hardly agree with the sweeping statement that the public is always unreasonable. It is our experience that the average public is a pretty decent public. Perhaps, who knows, what unfriendly feelings the public may entertain toward us may be largely our own fault. Don't we usually get what we give in all other relations of life? Maybe the same principle obtains in this matter.'"

New Motorman's Air Brake Valve

A new motorman's air brake valve, type "S" form "J," made by the Canadian General Electric Company, weighs only 10 lbs., is simple in construction and will, it is claimed, reduce valve maintenance to a minimum. The principal parts are the valve body, bonnet, valve stem and rotary valve. The rotary valve operates on a raised seat which is formed on the upper surface of the valve body. The ports, which are located in the seat, are drilled accurately to size and position. The location of these parts is arranged to perfectly balance the rotary valve, and to reduce wear to a minimum. The wearing surface of the rotary valve is provided with ports machined accurately to size and position. These ports register with the ports in the valve seat when the handle is in the different positions. An oil well is formed on the upper side of the rotary valve this oil well being directly below the oil hole in the valve bonnet. A small port is drilled from the oil well to a groove machined in the lower surface of the valve and serves to distribute the oil over the wearing surface. The valve stem is of steel, case hardened, and is provided at the base with a leather gasket having a broad wearing surface to prevent leakage between the stem and bonnet. The valve bonnet is provided with a bushing of composition material which serves as a bearing for the valve stem and can be removed when worn.

The surface of the valve quadrant which is machined to indicate the different operating positions of the valve handle, is case hardened to prevent wear from the movement of the



New air brake valve.

valve handle. The valve bonnet is provided with a case hardened wearing pad which relieves the stem of strains due to motorman leaning on the valve handle, and also reduces wear between the stem and handle to a minimum.

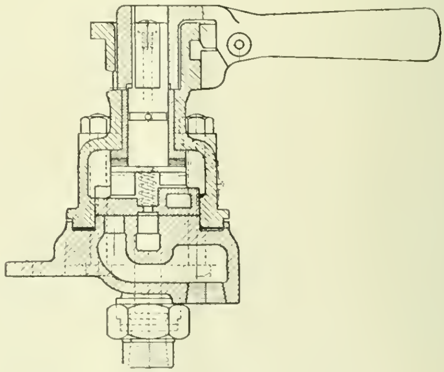
The following are the positions and functions performed by the valve when moving the handle from the extreme left to the extreme right position:

Release Position: Direct connection is made between the train line and exhaust through a large port.

Restricted Release and Running Position.—Train line is connected to exhaust through a restricted port in order to give a graduated release of the brakes.

Lap Position: All ports are blanked. This is the only position in which the handle can be removed.

Service Application Position: Connection is made between the main reservoir and train line through a port of such size as to give a prompt application of the brakes.



Showing interior construction of valve.

Emergency Position: The valve handle is at the extreme right and a large port is opened from the main reservoir to a train line in order to give a quick application of the brakes in case of an emergency.

Illumination

An Exceptionally Well-Lighted Railroad Shop

The manifold advantages of having adequate illumination in an industrial plant are being realized by no class of operators more readily than the far-seeing railroad men. Not only does the proper illumination of a shop mean a better and more efficient class of work turned out, but exhaustive tests recently made in a large industrial plant proved conclusively that a workman actually made a gain of several minutes per day in the production of a given piece of work, owing entirely to the better illumination with which he was supplied. These few minutes when multiplied by a large number of workmen amount to a considerable item.

There are shown herewith some views of an excellently lighted boiler and erection shop of a prominent eastern railroad. As will be noted, the illumination is abundant but entirely without glare or shadows, reaching every part of the shop. The buildings are 528 feet long and 58 feet wide, giving an area of 30,624 square feet in each building. The illumination for these buildings is furnished by type Z Cooper-Hewitt quartz lamps operating in a 220-volt direct-current circuit. This lamp is a modification of the well-known Cooper-Hewitt lamp based on the same fundamental prin-

Properly lighted erection shop.

ciples, but possessing some essential differences. The details of construction have been described in the trade technical press. The lamp uses mercury vapor and a short tube of pure fused quartz instead of the long tube of lead glass used in the older types. Ten lamps are installed in the boiler shop placed at regular intervals of 52 feet down the middle of the building, each lamp lighting an average of 3,062 feet. In the erecting shop there are twelve lamps regularly spaced down the middle of the building at intervals of 44 feet, giving an average space lighted by each lamp of 2,552 feet. All the lamps are hung at a height of 50 feet above the floor. The lamps are rated at 2,400 candle-power with an energy consumption of 725 wats, or a total for the installation of approximately 16 kilowatts. The light afforded by these lamps is entirely sufficient for all purposes even the locomo-

Workmen save time with good lighting.

tive pit being well illuminated. The only other form of artificial light required is a portable hand lamp needed by the workman when he goes inside the boiler. The total lumens per lamp from these units is 14,603, with a total available in a zone of 0 to 60 degrees of 10,800 lumens per lamp which, with a wattage of 725 gives a value of 20.2 total lumens per watt, and 14.9 available lumens per watt.

The efficiency of the system as installed is made evident from the low wattage consumption obtained per square foot, those being .28 for the erecting shop and .24 for the boiler shop, the former being claimed to be the best lighted erecting shops in the country. The average candle feet obtained is 4.24 for the erecting shop and 3.53 for the boiler shop.

No better evidence of the success of the installation from a practical viewpoint can be secured than the universal commendation of the employees who are working under the light. They are universally pleased with it and the results they are able to obtain. It is interesting to note, however, that when a trial installation of four lamps was first made, there was a certain antipathy to the light on the part of the men employed, because of the difference in color value, but this speedily disappeared after they gave it a thorough trial. This trial resulted in the adoption of the complete installation of these units. The lamps have been installed at various times but the entire installation averages practically 16 months and the

maintenance charges for the period totals $134.54 or $4,58 per lamp per year.

Industrial Reflectors for 750 and 1000 watt Lamps

Three new types of reflectors for industrial service in connection with the new 750 and 1,000 watt mazda lamps are offered by the Holophane section of the Canadian General Electric Company. Of these Fig. 1 is a deep bowl steel reflector 15 inches in diameter, finished with porcelain enamel, white on the inside, and green outside. It is fitted with a 3¼-inch B-type heel for use with the holders described below. This unit is very efficient in directing the light downward, a high percentage of the emitted light being in

Fig. 1

the zone from zero to sixty degrees. The distribution is characteristically extensive. The angle of cut-off is fairly low—about twenty degrees below the horizontal.

Fig. 2 is a shallow dome steel reflector, 20 inches in diameter, with porcelain enamel finish designed to give the correct filament location with these large lamps; 3¼-inch B-type is provided. The angle of cut-off is about fifteen degrees below the horizontal. The candle-power distribution curve produced by this unit is widely distributing. Both of these re-

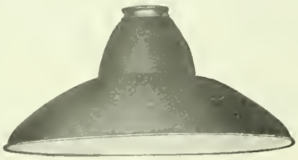


Fig. 2

flectors are of use in lighting any large manufacturing area where the ceiling is high and the lamps can be hung well out of the angles of ordinary vision. On account of its greater angle of cut-off, the bowl type may be hung somewhat lower than the shallow dome. In foundries or erecting bays, these may be located above the crane travel so spaced as to give even illumination on the working plane.

Fig. 3, is a bowl shaped metal reflector, 15 inches in

Fig. 3

diameter, with the holder set at an angle. The unit has the standard porcelain enamel finish and is fitted with a 3¼-inch B type heel. It is constructed to give maximum candlepower at angles of from thirty to forty-five degrees from the vertical. The equipment is useful for lighting large bays where it is desirable to locate the lamps at the sides, below the crane travel.

New Shade Holders, Receptacles and Covers

A new line of shade holders. receptacles and covers for outlet boxes has just been put on the market by the National X-Ray Reflector Company, 235 W. Jackson Boulevard, Chicago. The shade holders are made of stamped steel and are remarkably rigid and substantial. The holder is secured

Fig. 1

in place by two screws which thread into the box cover, and serve to keep the porcelain receptacle in position. Three types of holders are available, 2¼-in. form "O," 2¼-in. form "H," 3¼-in. form "A." Receptacles can be supplied with either sealed terminals or clamping terminals. The box covers in 3-in. and 4-in. sizes are punched and tapped especially for the X-Ray receptacles. Covers, receptacles and hold-

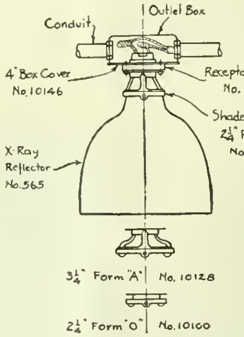


Fig. 2

ers have been designed as a unit, and assure the correct relation of lamps and reflectors. It is possible with a reflector and various combinations of box covers, holders and receptacles to make up a complete lighting unit to cover any outlet box. Figures herewith illustrate the new devices and show how easily they may be installed.

Illustrations in the current issue of "Telephone Talk" show interior departments of the plant headquarters of the B. C. Telephone Company, and several articles deal with plant matters. One sets out what has been accomplished by the company in the construction of outside plant and the installation of interior equipment, until today the telephone system of British Columbia is in excellent condition. Announcement is made also of the opening of two new exchanges at Colquitz, Vancouver Island, and at West Vancouver, making a total of forty-one exchanges now operated by the company in the province. Continuous service is given at all points, every telephone owned by the company being available at any hour of the day or night.

Store Window Decorating and Lighting

The Value of the Window in Drawing Trade—Must Distinguish "Over" Decoration from "Effective"—Criticisms and Suggestions for a Number of Typical Locations

By Mr. E. N. Hyde*

When the shoe merchant or his competent assistant glances at a pair of shoes in a competitor's store, he very frequently can tell at a glance the quality of the shoe, the price it cost the merchant, the retail price to the user and the consequent gross profit. His mental calculation does not stop there, however. He sees the something further in the last. Either it is extreme here or there, or it lacks certain lines needed to make it a good seller, or it is designed to look well at the expense of comfort, or it has in its proportions something, which with a few is popular and with many undesired, or vice versa—and he knows too that it will sell better in some parts of the city than in his own store. In other words, he sees the shoe as a commercial possibility.

When a person in need of a pair of shoes walks along a street he looks in the shoe shop window for ideas of latest styles, latest colors in light leathers, such as tans, and he imagines he can see his foot as it would appear in this or that or another shoe exhibited. The price interests him and he looks for the tag on a certain shoe which appeals to him most strongly. Thus attracted by the shop window samples he steps inside and it is only once out of a dozen or

Window No. 1—Little to criticize.

more times that he comes away without purchasing. He has in this act done three things without being very conscious of any of them. First, he has confirmed the merchant's commercial acumen in the choice of his lasts, styles, colors, etc., as first mentioned. Secondly, he has secured what he wanted or had in mind when he started out, and thirdly, he has succumbed to the silent selling power of the shop window, which was the magnet that drew him into the store. It is this magnetic power of the window at night that forms the theme of this article. If there was no way of lighting it, its hours of usefulness would be those before daylight failed. To do the same service at night, when more than ever people nowadays do their buying, those shop windows must be lighted so that their attractiveness at 9 p.m. is no less than at 12 o'clock noon. A lighted window to be right must aid the eye in taking in every detail and bring clearly into vision of each one who looks all the characteristics of the lines on view, or else the merchant's acumen in

Window No. 2—Attractively dressed.

choosing his lines is not reaping its fullest reward, and the skill in dressing the window is wasted. To one who knows, the number of defects that exist in lighting shop windows of all kinds is appalling. The good window is not hard to obtain when a few fundamentals are considered and observed, and neither is a technical explanation necessary to make the essentials fully comprehended. There is, however, a woeful lack of understanding of just what happens to the light given off by light sources when surrounded by different light redirecting media and what follows is presented to our readers in hope that they will not permit themselves to be victimized by faulty designs in appliances used or incorrectly designed systems of lighting. To better illustrate six photographic reproductions of windows are given and the good and bad features of their lighting systems pointed out with suggestions as to how to correct some of the faults where they exist. The photographs were taken with this in view and because they represent typical cases most frequently encountered. Before discussing the photographs, however, a few general details for consideration are outlined.

Conspicuousness: The objects to be sold must in

* Illuminating Department Northern Electric Company, Limited.

all cases be the most conspicuous and attention-attracting objects that meet the eye. This must be construed to mean that shoes must not be less conspicuous but must be more conspicuous than anything else in the window, if it is a shoe shop window.

Comfort: When the glance falls on the shoes the eye must not be offended by any discomforting sensation, but on the other hand, must receive a sensation that is agreeable to the owner, so that the longer he gazes the more pleasing are his sensations.

Window No. 3—Lettered sign a clever device.

Contrast: A clear distinct outline of the shoes must be observed so that their proportions are unmistakably defined. Their colors must show distinctly and definitely when compared with each other. The background must set off the first, the trimming on which the shoes rest must accomplish the last.

Quantity of Light: The window must be bright inside. A quantity of light is needed to make it very much brighter than the outside lighting due to signs, street lights, ornamental standards, or neighboring windows. The contrast varies with the number of lights or their size, depending on surroundings.

Window Construction: Dimension, shape, height, colors of woodwork, etc., forming the background, the presence or absence of a "false ceiling," the presence or absence of a transom of translucent or other kind of glass above the false ceiling, and the depth with its consequent floor area, and lastly but of great importance, the presence or absence of a sash of clear glass or mirror at the back or store side of the window. Depending on these simple observations one has ammunition to get the best results.

Equipment: The reflecting devices which can be used or which are used must depend on the kind of window, but they are simple of classification. Let us analyze window No. 1. This is a well-lighted window that was no harder to illuminate properly than are many.

Window No. 1

Feature 1—Has a false ceiling.
" 2—Has a glass transom above false ceiling.
" 3—Is very shallow.
" 4—Has light wood trimming in oak.
" 5—Has no wood shelves projecting to intercept light falling from overhead.
" 6—Recedes from the sidewalk and has little light from nearby sources falling on it.
" 7—Height of false ceiling not over 7 ft. above floor of window.

Present Equipment:—

1—Glass prismatic reflectors placed over round holes cut on false ceiling. The prismatic reflectors let light through to illuminate glass transom (Note—opaque reflectors would not have accomplished this lighting in two directions).

2—Window being shallow a wide band at the top translucent at night cuts view of lamps and reflectors out of range of vision thereby avoiding glare. Splendid feature.

3—Transparent band provided with letters giving the trade mark a clear expression to people on opposite side of the street. Splendid feature.

4—Has small lamps using comparatively little current as larger ones are not needed (see feature 6 above). So window is bright by contrast and is not over illuminated, with consequent low cost for lighting.

Window No. 4—Badly illuminated.

5—Wood background not highly polished or varnished does not reflect the light sources or blur the image of the shoes.

6—Windows being very shallow, to keep the light sent out by reflectors within, these reflectors should be concentrating. Those in use distributing. This is the only defect in the whole scheme, and in view of results is a minor one.

Advantages to be noted:—Shoes are clearly defined. Little glare, from direct or reflected image of

light source, in range of vision to cause the observer to squint or feel uncomfortable or to tire the eye as it looks and sees each shoe and its color by reflected light aided by sharp contrast.

Window No. 2

Feature 1—Ceiling high.
" 2—No false ceiling.
" 3—No transom.
" 4—Has light wood trimming.
" 5—Has no wood shelves projecting to intercept light falling from above.
" 6—Recedes from the sidewalk.
" 7—Has large exposure parallelling street.
" 8—Has lots of light from surroundings, making outside illumination very high.
" 9—Has sub show case on level with pavement.
" 10—Is comparatively deep.
" 11—Has low background arrangement above which are glass paned window sashes, perfectly transparent, obviously to let light into the store room.

Present equipment:—

1—Has two-light opaque mirrored reflectors of the trough pattern, wide of mouth. Set at intervals and close to plate glass window front, visible from street.
2—Lamps comparatively small and consequently quantity of light not great.
3—Contrasted with outside high illumination, window not very bright.
4—Reflectors designed to keep the light in the window not on the sidewalk. Splendid feature.
5—Clear image of reflectors seen in glass of back sashes, contributing glare.
6—Sub show case properly lighted, no light sources being seen and shows showing clearly and brightly. Could not be improved upon.

Suggestions for Improvements:—

Reflectors are of wrong type, should be opaque; mirror very deep—(X-Ray Helmet suitable).

Lamp should be 100 watt size but only one used where two are now to bring up illumination so as to better outshine the illumination of the sidewalk.

Some very flimsy silk—fabric white in color should be draped over back window sash to shut out reflection of the light sources whose images and their glare effect would disappear. This draping permits daylight to enter store much the same as before.

A silk or appropriate drape not more than 18 inches deep should be stretched at top of window inside so as to intercept view of "helmets." This would improve appearance as now seen with "poke bonnets" which instead of helmets are being used.

With these changes the writer can think of no criticisms that could be offered. As it is the window gives a fair appearance and is very attractively and tastefully dressed.

Window No. 3

Feature 1—Ceiling fairly high.
" 2—False ceiling.
" 3—No transom above false ceiling.
" 4—Wood trimmed—finished white.
" 5—Has no wood shelves to intercept light falling from above.
" 6—Recedes from sidewalk.
" 7—Medium depth.
" 8—Has white background (not polished) running from bottom to top.
" 9—Surroundings fairly bright in vicinity.

Present equipment:—

1.—Cased 7-in. green outside, white within glass reflectors, set over holes cut in false ceiling.
2—Broad band, translucent with trade mark as in window No. 1. Same effect.
3—Lamps small in size—but plenty large enough due to
4—Low absorption of white background.

Suggestions:—

System of lighting all right.

A reduction of large white area inside with some relieving tone in panels would give warmth now lacking. Otherwise a fine window. The lettered sign is a clever device, the reading of which can be changed at will, and calls attention to the latest in fall footwear.

Window No. 5—Good for certain localities.

Window No. 4

Feature 1—Glass mirror, panel ceiling.
" 2—Bare lamps protruding from centre of each panel (12-in. x 12-in. approx.)
" 3—Mirrors for background.
" 4—Large exposure parallel to street.
" 5—Medium depth, exaggerated by mirror.
" 6—Surroundings not overly bright on near side, opposite side yellow flame arcs.

Present equipment:—

1—Lamps as above described set in mirror panels.
2—No other reflectors.
3—No translucent band.
4—Every lamp filament in plain sight, each lamp making a bright spot more conspicuous than any shoe in the window.

Suggestions for improvement:—

This window is wholly wrong from a good lighting standpoint. The glare of the lamps attract and offend, and take attention from the shoes. The eye is quickly fatigued and seeks relief elsewhere. The flat mirrors in the ceiling besides exaggerating the glare, by reason of their regular or specular reflecting properties, and because they are perfectly flat, send, or permit, as much or more light to pass out of the window on to the street as on to the shoes beneath them. The mirrors below reflect the back of the heels and when the shoes are tilted toe downward reflect the

soles besides destroying clearness in outlines and confusing shapes.

To permanently improve, rip out the whole equipment and follow scheme No. 2 and suggested additions to No. 2 in the way of draperies.

To temporarily improve, drape with white the lower

Window No. 6—Good at all points.

mirrors and curtain windows at top with at least 18-in. deep opaque curtains.

Window No. 5

Feature 1—Ceiling moderately high.
" 2—No false ceiling.
" 3—No transom.
" 4—No translucent band.
" 5—Background obscure.
" 6—Front parallels pavement.
" 7—Side right angles to front.
" 8—Moderately deep.
" 9—No sash on store side.
" 10—Flame arc outside.

Present equipment:—
1—Pendent glass reflectors.
2—Lamps for which reflectors are not designed.
3—Lamps very large size, filament all in range of vision.
4—Window piled with shoes tight against the plate glass.

Comment:—

The suggestions for improving this window are made on the basis of the proprietor's idea of what constitutes a successful show shop-window. Commercial success depends on knowing the people in the vicinity of your store. They may have no idea of the style or fashion in shoes. They buy only because necessity compels them to part with money for something that will protect their feet. The long wearing quality and the strength to resist rough usage are the features most desired by this class of buyer, who is likely to be impressed by the size of the stock, its mechanical construction of durability, and the apparent show and brilliancy of the shop window—and store, more than anything else. The proprietor of Shop Window No. 5 has made his window display to attract this class of buyer. From the standpoint of illuminating engineering the window is a failure. As a means of getting customers for the goods sold within, the window is a success. Thus psychology plays its important part in the affairs of all and sets aside the best meant schemes of scientific preparation.

Suggestions:—There is no perspective to a window piled to the front until the soles of boots and shoes heaped promiscuously, press against the plate glass front; also boots and shoes being opaque do not let the light within the window pass through the heap. The only way to show the jumble is by an outside light. Hence the flame arc is good for the purpose.

The lamps within the window are put in reflectors for which they were never intended and boldly glare in every person's eyes, but they make the window bright. They should be covered with reflectors designed for them, and the vacuum lamps could be replaced with a fewer number of nitrogen filled lamps which would still more greatly increase the over-brilliancy of the window.

The flame arc lamp outside, hung low as it is—is certainly to be condemned as a disagreeable source of glare for all persons passing on both sides of the street, but it is the great illuminant needed to show off the heaped shoes within the window. To eliminate the glare and to still further illuminate the shoes pressing against the glass front, a shade reflector which would intercept all light radiating from the lamp up and down the street or backwards to the opposite side of the street, should be put around the lamp and the rays thus intercepted redirected to the shoe shop front, which would be much more highly illuminated than it is now. The spot where the store is located would be more conspicuous by far than it is now, to anyone riding or passing along the thoroughfare where it is located.

Window No. 6

This window is next mentioned because it is in such contrast to window No. 5. Everything within is shown

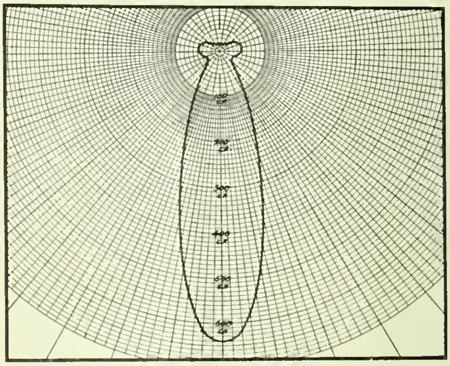


Fig. 7 Showing great concentration of light by special reflector.

to appeal to good taste and elegance, and each sample has a distinctive feature to be clearly revealed:—

Feature 1—Window high.
" 2—No false ceiling.
" 3—No transom above false ceiling.
" 4—Is very deep.
" 5—Trimmings—rather light in hue.
" 6—Wide space parallel to sidewalk.
" 7—No obstruction to light distribution by shelves.
" 8—Outside lighting rather high but not glaring.
" 9—Ornamental post standards give char-

acter to the store location and having large diameter globes the effect is not offensive from standpoint of glare, but on the other hand attention attracting and conspicuous.

Equipment:—

Prismatic glass reflectors suspended from ceiling.

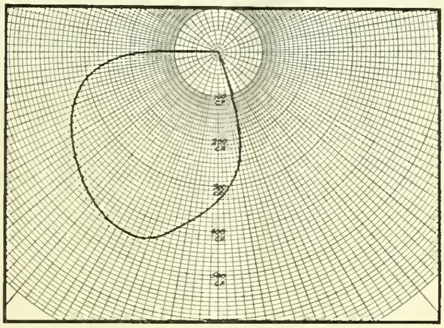


Fig. 8—Poke bonnet reflector directs the light where most required.

Windows furnished with curtains controlled from inside.

Wood Arches:—increasing perspective.

Suggestions:—

Window fine. Higher intensity to increase contrast with outside lighting desirable. Concentrating reflectors instead of distributing now installed, would do this without increasing cost for current.

Window curtains on street exposure should be kept 18 inches below window top to cut light sources from view.

Heavier diffusing quality of glass balls on post standards, should be used so that no bright spot can be seen indicating the location of the lamp filaments. Aside from these minor changes the window is fine from all standpoints.

Types of Reflectors

Prismatic reflectors are used with greater frequency in show windows of all kinds than is any other type.

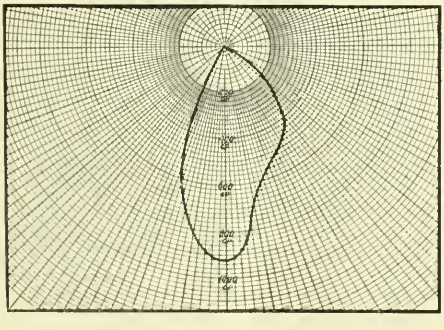


Fig. 9—Curve showing unsymmetrical distribution of light by helmet reflector.

They are made to give several degrees of concentration and Figure No. 7 shows a characteristic curve of extreme concentration. For shallow windows, or for high windows, these are suitable. They can be installed with the receptacle placed close to the plate glass of the window and when necessary to throw the light high on the background they can be "staggered," that is to say, the lamp tip is made to point at the desired spot on the background, and the next lamp placed with the tip pointing to the floor of the window. If a transom is used as in Window No. 1, they have a decided advantage, in permitting about thirty per cent. of the available light to radiate above or in the "upper hemisphere," and lighting the transom, while the balance is concentrated below.

The Poke Bonnet is a convenient unit type A trough reflector. The characteristic curve given (Fig. 8) shows how it changes the direction taken by an ordinary lamp. It is opaque and gives no upper hemispherical light but is efficient. It is wide at the mouth and displays the lamp within. The view of the reflectors in Window No. 2 is wholly due to reflections. The poke bonnets were not in range, but their image in the clear glass, window sashes on the inside or store side of the window reflected them very clearly —as shown. Had the helmet reflector been used, this

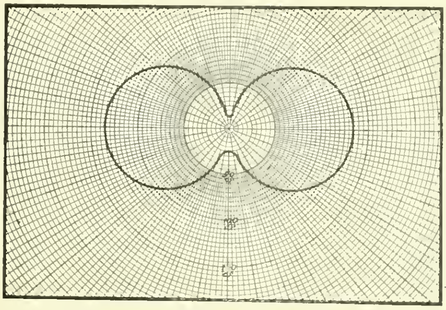


Fig. 10—Distribution of light using no reflector.

would not have been the case. The deep bowl shaped reflector gives wonderful concentration, besides sending the light towards the background. The uneven kind of distribution shown clearly in Fig. 9 is known as assymmetric. The units in all cases should be kept from view either by means of transparent band, or by drapery. If used where there is a transom to be lighted above the window, additional lights must be installed, just to light the transom. When making comparisons of the way light is directed by reflectors it is necessary to know how light radiates from a bare lamp. Fig. 10 gives the characteristic curve of a mazda lamp, with the drawn wire tungsten filament burning in vacuum.

In conclusion we suggest that each show window be regarded as a stage. The shoes as the conspicuous objects, the background as the background of the window, the lights concealed except for ornamentation, as are concealed the foot lights, the border lights and strip lights, which throw all their radiations to the stage without being in range of vision. The darkness of the auditorium accentuates the effect. The lowness of the outside illumination likewise makes the window look brighter by contrast. Special pains were taken by Mr. E. P. Wallace to photograph windows selected by the author and the skill with which the work was done deserves special mention and appreciation.

The Dealer and Contractor

Electricity in Homes and Stores Vitally Concerns the Electrical Contractor and the Central Station

One of the principal things about which we are all concerned is the application of electricity to houses and to stores. One of the things that is being tried by our committee is an attempt to get some standardization in the matter of plugs and receptacles, and I want to read to you just an excerpt from a report by the Commercial Section Committee on Wiring Existing Buildings, on the subject of standardization of plugs and receptacles. It says:

"The question of standardizing plugs and receptacles was referred again to this committee, and the committee has discussed it thoroughly at its meetings and the chairman has had interviews with the underwriters and the manufacturers, but can only report progress and not too much of that.

"As pointed out in our last year's report there are two questions: First, the classification of plugs and receptacles into a large and a small size. At present nearly all plugs, with the exception of the ordinary screw plug, are good for more than six amperes, so that underwriters consider the installation of a receptacle which will take a plug that is good for more than six amperes as evidence that devices taking more than six amperes will be used on the circuit ,and, therefore, the inspectors require such receptacle to be on a separate circuit and not on a lighting circuit. The result is that the wireman and owner install ordinary sockets on the lighting circuit even in places where receptacles would be better practice.

"In order to obviate this, last year's report suggested classification into large and small receptacles, of which the small size should be allowed on lighting circuits as freely as sockets, but no single manufacturer is ready to so classify his receptacles, because he knows the only result will be to limit the sale of his device, and up to the time of writing the underwriters have felt that they should rate a receptacle up to its safe limit.

"However, the chairman of the committee has had conferences with the underwriters, with a view to ascertaining if they would not consent, when the manufacturer asked them to limit a plug to a capacity of, say, six amperes or less, and agreed not to put it out as good for anything more than six amperes, that in these cases the underwriters would direct their inspectors to allow receptacles for such plugs to go freely on lighting circuits. If this can be done it will warrant some of the manufacturers in limiting their plugs to capacities that can be safely allowed on lighting circuits, and will then result in a receptacle for such plugs being more freely used on lighting circuits instead of using sockets for heating devices. Unfortunately the underwriters so far do not wish to take this action. We cannot believe that the underwriters prefer to see 600-watt devices used from sockets rather than from receptacles, but that is the result of their present rules and interpretations.

"As regards the actual standardization, so that all plugs and receptacles in a given class should be interchangeable, here we run into the question of patents. The National Electric Light Association obviously cannot make any standard which is tied up to a patented article. The only hope would be to get the manufacturers together, and thus far this has proved impracticable. The only way would seem to be some sort of pool, and this would be difficult anyway, and probably repugnant to the laws against monopolies.

"Possibly the time may come when a plug and receptacle shall be made sufficiently good to warrant the Association in recommending it as a standard, and at the same time sufficiently free of patent restrictions so that this course will be proper.

"We can only report progress, and suggest that some committee of the Association should continue to watch the matter and do what is possible toward the desired end."

The question of standardization has been an exceedingly important one to the central station company. The fact of one or more appliances being sold on different types of plugs is repugnant to the user of electricity, and limits, to a large extent, their general application, and anything that this Association may do with reference to recommendations along lines of standardization for all plugs and receptacles will meet with hearty co-operation from the Commercial Section of the National Electric Light Association.

Plugs and Receptacles

Now, from the question of standardization of plugs and receptacles I want to carry your mind a little bit to the actual co-operation as pointed out specifically in an example that I am going to speak to you about, between the central station and the contractor, as evidenced in Brooklyn. We have a scheme there whereby the top of the contractor's window is painted with the words, "Edison Light and Power Applications Received Here." Beneath that sign, which extends across the entire width of the window, and three feet deep, is the name of the contractor, with any additions he may want to make, such as "Wiring," or "Motors Installed." This window is lighted at our expense from dusk until midnight, and the contractor represents us in all his dealings.

There are twenty-six of such windows as I have described, belonging to contractors, in the Borough of Brooklyn.

Now, that is one specific method of co-operation, and I cite it to you as evidence that we have suggested a definite means of co-operation.

In addition to that window, we give the contractor what we call a "Contractor's Red-Book." This book, in effect, is a package of postal cards, and our customers go to the contractor nearest their location, if there is any complaint about the Edison service at that point. The contractor then writes us a postal, saying that he has a complaint from some particular customer, and will we look into it, and we reply to that contractor, giving the particulars of any complaint that may be made.

Now, I want to call your attention to a most important detail, and that is a class of customers which the central

station has not been able to get. This is the customer who pays a dollar, or less, per month. It is easy enough, as a general rule, to get an applicant to take current for his house where he has a fairly good sized house, and where he is going to pay from two to three or five dollars a month. Such customers are remunerative, but there are lots of customers in localities where there is no minimum guarantee per month, or, even where there is a minimum guarantee of a dollar a month, who burn from six cents to a dollar's worth of current a month, and which are absolutely unproductive. In the city of New York alone there are five thousand customers in apartments and houses, whose monthly bills are less than a dollar a month. According to the actual cost figures, under our present method of service (the cost of the cable to premises, the cost of the meter reading, the cost of the billing, the cost of the meter itself, and the cost of the lamps), no station can supply a customer and make a profit, whose income is less than a dollar a month.

The obvious question, therefore, is—How can we make that customer a productive customer? Now, the obvious answer to that is, Get rid of your fixed charge. And when you ask—what is the fixed charge? the reply is that the meter is one of your most expensive items, and lamps are another expensive item in the service of such customer. So ways have been thought out to get this customer, but with a reduced equipment. One way is to get rid of the meter. Suppose you go to the milkman and say, "I want a quart of milk left at my house every day for a month, for which I will contract to pay you seven or eight cents per quart." Suppose we could fix it so that the same method could be applied to the supplying of current and the customer should say, "I want you to supply me with a hundred watts of electricity delivered to my house continuously, for use any time I want it, and I will agree not to use more than a hundred watts. Can you sell current to me that way?" The answer is, "We believe we can." That is the method upon which we are working now—that is, to sell, in place of kilowatt hours, so many kilowatts of demand per month, and we will put on that installation simply a cut-out, which, when a man gets above a hundred watts, will flicker his light, or cut him off. Now, that customer can put into his house twenty-five, thirty, or as many lamps as he may desire, but he cannot use more than a hundred watts at a time. That is the method that they are pursuing in Milan, Italy, and in Germany, where they sell as low as thirty or forty cents worth of current per month.

Everybody Using Current

What is the result? We get all the poorer classes using current. Many of the negro plantations around New Orleans today are buying current on such a device, which here is called an excess indicator. You will say, "Of course, that is easy enough for the central station company to do that, but if it so hard for you to get a dollar out of a man for the current, what are we fellows going to do about wiring the house?" That is an important item, and what we want you contractors to do is to get together and adopt, or get approved by the underwriters, as we have been trying to do, some cheap method of wiring, which will carry safely and will at the same time limit the expense.

Mr. Doane, who will speak to you to-morrow, will present to you samples of different types of wiring that are used abroad. Some of you will say that a great many of the conditions that are seen abroad could not be duplicated in this country, because the fire hazard here is too great, because most of our buildings are of wood, while abroad the majority of them are made of stone, or brick, or other non-inflammable material. But they have adopted abroad, as you will see from the material which Mr. Doane will show you, some of those types of wiring which go with the limiting device.

The thing I want to point out to your attention especially is that so far as the central station is concerned, it is directing its energies toward getting the small consumer, who is now on a non-productive basis, up to a basis where he will give us a net profit.

From the question of the small consumer, naturally, one comes to the question of installment wiring. In Brooklyn and New York we have a slogan, "Wire your living rooms for forty-nine dollars." Immediately a contractor hears that, he goes away up in the air, and he says, "Why, it is absurd. We can't make any money at that rate," and we say, "We don't expect you to; we have no more idea of getting only forty-nine dollar customers than we have of getting thousand dollar customers, but you have to get bait first, to get your fish, and the forty-nine dollars is the bait." When we advertise, as we do, all throughout Brooklyn, "Wire your living rooms for forty-nine dollars," while we have a type of fixtures, and while we have a number of contractors who install this wiring for this figure—and they all do this—we don't do it ourselves—we do that for advertising purposes, and naturally expect larger customers and we get them. It will interest you to know that last year eighty-seven per cent. of all the inquiries that were attracted by the forty-nine dollar proposition, spent a hundred dollars or over in their wiring. This, I think you will agree, justifies the fact that the advertising value of the forty-nine dollar proposition was all we cared to bring out. So when you see central station companies advertising propositions which you contractors may consider absurdly low, don't judge it by the amount you see advertised, but by the thought which is back of the small figure.

First Catch the Eye

There are two things that you have to do before you get a man to be a customer. First, you have to get his eye—you create his interest; and then you instil the desire to buy. That forty-nine dollar figure creates his interest, and when he investigates how cheap that is, he goes a little further, and the desire to buy is the necessary follower of the interest that you have at first created. Take that forty-nine dollar proposition—even the figure nine has a great advertising value. You never saw a department store advertise anything at a dollar, or at fifty cents—it is always ninety-eight cents or forty-nine cents. It is always the odd cent, because that is the psychological thing that catches the eye, that creates the desire to buy.

Here are two pamphlets, one by the Union Gas and Electric Company, of Cincinnati, that goes quite to some length in describing their proposition. It says that the object of the campaign is to make it possible for the owner or occupant of any unwired home to enjoy electrical service. "We will equip your house with wiring and fixtures at the lowest possible cost."

In Brooklyn we attract the man with the forty-nine dollar proposition, and then, wherever that inquiry originates, we send our representative to the nearest electrical contractor to that location, and take him to the house, and he goes over what the applicant wants. The applicant tells the contractor what he wants done, and then we write an agreement for the customer, saying that he will authorize us to contract for his electrical wiring, and we have the contractor do the wiring just as the customer wants it done. Whenever wiring is done we pay the contractor in full, and the customer pays us in partial payments, with his monthly bills, as they come due.

Now, we have gone further than that in Brooklyn. We say to any contractor in Brooklyn, "If you have a reliable prospect, who can't afford to buy a motor, and he is a good

business risk, we will buy the motor for him from you." In other words, we will finance the purchase of that motor, the same way as we finance the wiring. That has worked out very satisfactorily. Of course, you must realize that we cannot put these motors in haphazard. The layout must be carefully studied; the engineering risks must be carefully worked out by those men who are experts in studying out such situations. The customer pays for the motor at the same time he pays for the current.

A number of the contractors have asked me whether the time is ever coming when contractors are going to supply lamps, and I have answered them, as I answer you: I don't think it is. I think a great many of the central stations would welcome the handling of lamps by others than themselves, but up to the present time that has not been feasibly arranged, and the results, where it has been tried, have not proved generally satisfactory. I don't know whether the personal element enters into it or not, but while one or two cities have handled it satisfactorily, others have not. Objectionable as it may be, the carrying of lamps by the central stations seems to be a necessary adjunct to the business.

Now, from the lamps I want to go to another part of the business, and that is the question of appliances. Appliances sold by the central station company are simply a means of advertising. When we organized our display room in Brooklyn, I had every contractor in Brooklyn understand what the plan of the Edison Company in Brooklyn was going to be, in the display of appliances. I said to them, as I say to you, that we are selling electrical appliances for advertising purposes; but we don't believe in giving appliances away for the sake of selling current.

Value of Special Sales

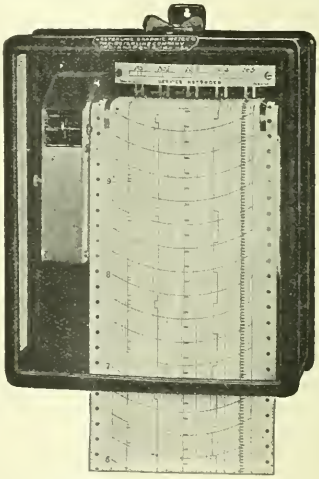
Now, we do believe in special sales at prices which will draw the trade. We have a special sale this month, of irons, at \$2.49. We have an attractive iron price from five manufacturers, and I had a committee of contractors in my office, and I said to them, "We are going to run, during the month of July, a sale of irons at \$2.49. We have a rate from five manufacturers, that will give us our regular profit on those irons. If any contractor in Brooklyn wants to sell the same iron at the same price we sell it, we will deliver the irons to him at our cost, plus five per cent. for handling." Now, what has been the result? Up to the present time—and I left Brooklyn day before yesterday—we have sold six hundred and fifty irons in our shop alone, and in addition, three hundred of the irons had been sold by twenty contractors throughout the Borough. I sincerely believe in special sales. They are not cut prices—they are introductory prices, which the manufacturer gives us, and which we give to the contractor as well as to ourselves. Furthermore, we say to the contractor, "You can take as many as you like; our stock room is yours, and if you have a call for five of the irons, you can get them in twenty-four hours, and not stock at all."

One company, a year ago, sold a four dollar toaster for \$2.00 retail, with a corresponding reduction in the cost of the article, and they advertised it in a leading magazine throughout the land, as a special day. We advertised it and the contractor advertised it, and what was the result? In one day we sold twelve hundred toasters. But that wasn't all. It wasn't only the twelve hundred toasters that we sold, that we cared so much about. That wasn't it. Four hundred of the twelve hundred customers who bought toasters bought something else. That, to my mind, is absolutely the essence of merchandising principles. The sooner contractors realize that if they are going to get along in their contracting business, they have to adopt merchandising methods to bring the people into their shops, the quicker they will succeed. It is not the iron that you sell—it is the fact that the customer comes into your store and asks about something else. That is the reason for the special sales on appliances.

Don't think, gentlemen, that you don't want to handle appliances because there is no money in them—there is not much money in it per sale. But every time you sell an appliance you create a desire of the customer to buy something else. If you go into a Regal shoe store and meet a clerk who has been properly instructed, after he sells you a pair of shoes, he will say, "Will you have a pair of shoe trees, or some polish?" He does not say that because he wants to, but because he has been so instructed. When a customer comes into your appliance show room to buy an appliance, your clerk should say "Have you a light on your porch?"—or, "Do you wash and iron electrically?"—leading the consumer along electrical development of his home. Then we wouldn't have so many locksmiths with the name of "electrician" attached to them.

New Service Recorders

Keen competition in the manufacturing business has encouraged the development of a number of instruments and devices intended to increase efficiency in machine tool operation. One of the most indispensable instruments of this type is known as the service recorder. A new instrument of



Service recording meter.

the service recorder type has recently been placed on the market. This meter operates on the same general principles as common graphic or curve drawing instruments. It is equipped with any number of pens desired from one to ten inclusive. Each of these pens is controlled electrically. The pens rest on a long strip of paper or record chart which is driven through the meter at a constant rate of speed by a high grade jewel balance wheel type eight day clock. The clock may be equipped with gears giving five paper speeds of $\frac{3}{4}$, $1\frac{1}{2}$, 3, 6 or 12 inches per hour. An attachment can also be provided on this clock giving additional chart speeds of 45, 90, 180, 360 and 720 inches per hour. The clock is provided with stops so that its operation may be interrupted at any time. A regulator is furnished for adjusting the speed of the clock in service. Clocks are furnished with re-rolling device for winding up the finished record in the bottom of the case or this device may be omitted and the finished chart fed through a slot in the bottom of the cover, the record being torn off daily.

Record charts are supplied in rolls of 90 feet in length

and 6 inches in width. This record may be torn up in short lengths for convenience in filing. Perforations are provided along each margin of the chart which are engaged by pins on the clock driving roll insuring perfect alignment of the paper and accurate timing of the clock.

Each pen is so controlled that when a record is made a vertical line about one-eighth inch in length is drawn across the chart, the pen returning to the zero position after each record is made. The controlling devices for the various pens are connected to different machines in such a way that one record is produced for each operation or for a certain number of operations. On account of the paper travelling through the meter due to the clock, the resulting record is a series of short lines, the spacings of which represent the rate at which operations are being completed. If the machine is being operated up to capacity, the series of lines will be close together but if the machine stands idle for several minutes, a straight horizontal line will be drawn across the chart showing that no work was accomplished during this time.

The electrical control for the pens is very efficient and requires such a small amount of current that the power consumption is negligible. The instruments have high internal resistance and may be operated at any distance from the machines. One instrument may be located in the superintendent's or manager's office and operated by small wires connected to the machines located at various parts of the plant several thousand feet away. Any source of direct-current either storage battery, shop or trolley voltage may be used for operating the instrument.

On machines operating at a high rate of speed and completing a number of pieces or operations in a short period of time, it is advisable to gear the controlling device on the machine so that one line on the chart will represent 10, 100 or any other convenient number of operations. On account of the large possible number of chart speeds that may be obtained on this instrument, it is easily possible to get a suitable record on any class of work. If operations are completed at a slow rate, then the chart may be operated at a slow speed so as to shorten the record but if operations are a clearer record.

These instruments are also furnished with a counting attachment arranged in such a way that they total up the operations so that the total production for the day or period can be quickly determined direct from the recorders.

Service records are used for a variety of purposes in addition to machine tool recording. Each pen can be arranged to give a record of when motors or other machines are being operated and when idle. They are also used for traffic recording on steam, interurban and street railways. In this case, each pen is operated by trolley contacts and records the exact time of car passing a given point of the system.

This service recorder is manufactured by The Esterline Company, Indianapolis, Indiana. The general design of case, clock and other parts is identical with the standard line of curve drawing electrical measuring instruments manufactured by this company.

75-Ampere Trailer Connector

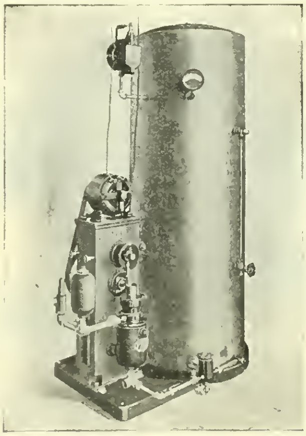
A new 75-ampere trailer connector, shown in accompanying illustration, has just been placed on the market by the Electric Service Supplies Company. Its design is identical with that of the standard 10-ampere type originated by this company about five years ago. This new type is to meet the demand for a connector having sufficient capacity to supply current for both lights and heaters in the trailer. The safety features embodied in the 10-ampere type of Keystone trailer connector are all contained in this new type of greater capacity. They are so designed that when the connectors are not in use the exposed metal parts are automatically disconnected, so absolutely eliminating any possible danger of shock to employees and passengers. The shells are of hard maple thoroughly impregnated with insulating material and waterproofed, so avoiding possible breakage which often occurs when hard rubber compositions are used. The connecting tongues are of heavy brass equipped with phos-

Trailer connector.

phor bronze retaining springs. Sockets for holding the connectors when they are not in service have been designed and are of either the same material as the shells of the connectors or of cast iron, black enamelled. In the cast iron socket no further insulation is necessary owing to the automatic disconnecting feature of all exposed parts.

The Paul Electric House Pump

A somewhat novel type of electric pump for residence use has been designed by the Ft. Wayne Engineering & Manufacturing Company, Fort Wayne, Ind. As shown in the illustration, the pump, pressure tank and all accessories are mounted on a bed plate forming a self-contained unit that requires only connection to the service pipes and lighting circuit to be ready for operation. The pump is driven by



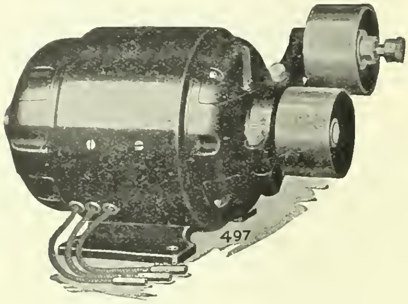
Paul Electric House Pump.

a small Westinghouse Electric motor, which is mounted above the floor from dirt and water, and is belted to a counter-shaft geared to the pump. The gears are enclosed within the cast iron stand on which the pump and motor are mounted. Included with the outfit are an automatic priming device, which insures a supply of compressed air inside the tank, and an automatic pressure controller which keeps the pressure within the tank adjusted from 30 lbs. minimum to 50 lbs. maximum. These pumps are furnished in sizes of 150 and 300 gallons per hour, with tanks of from 66 to 220 gallons capacity. The trade name is the Paul Electric House Pump.

The plant at Wasdell's Falls, constructed by the Hydro-Electric Power Commission of Ontario, was formally placed in operation on October 7th. This plant will supply Beaverton, Cannington and neighboring municipalities.

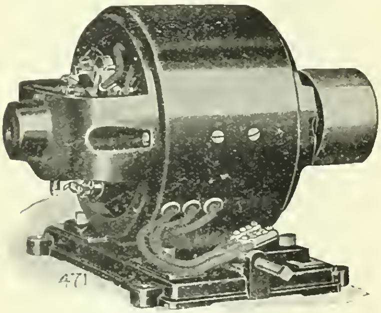
New Steel-Frame D.C. Motor

The illustrations herewith show a new type of direct-current motor, just recently placed on the market by The Robbins & Myers Company, Springfield, O. These motors have cast steel frames and are specially adapted for any service where the space for installing the motors is restricted, or where light and compact construction is desirable for any



½ h.p., fully enclosed, with idler pulley attachment.

reason. These motors are the bi-polar type and are made in four frame sizes with outputs of ⅛, ¼, 1/3, ½, ¾, 1, 1½ and 2 horse-power. They are supplied for operation on all standard voltages. The line includes open, fully-enclosed, semi-enclosed and grid type frames. The motors can also be supplied equipped with idler pulley attachments or back gears where this construction is desired. All standard outfits are



1 horse power, open type.

equipped with sliding bases, pulleys, and no-voltage release starters. The bearings are phosphor-bronze and are lubricated by oil rings. The pole pieces and armature core are built up of steel laminations. The armature coils are wound directly into the slots. The brush holders are mounted on an adjustable rocker and are the sliding box type.

New Switch and Distribution Cabinet

The Detroit Fuse & Manufacturing Company have recently brought out a new line called the "Square D" Enclosed Entrance Switch and Distributing Cabinet. This new line is made in Canada and salesrooms have been established at 216 Wyandotte Street East, Windsor, Ont. Safety and simplicity of operation, the housing of all live metal parts, steel construction and reasonable price combine to make this one of the best lines of entrance switch on the market. The line, at present, consists of a single box, containing a double pole, 30 ampere 125 volt combination switch and cutout, for Edison plug fuses; a double compartment box in one side of which is mounted the same type of switch and cutout as in the single box and in the other side is mounted a two-wire, double branch Edison plug cutout; also a double compartment box with a main line switch and cutout in one side and two two-wire double branch cutouts of the Edison plug type in the other side. These cabinets are substantially made of No. 16 Ga. steel, with corners electrically welded—the finish being baked-on black enamel. The partition in the double compartment boxes is of sheet steel also electrically welded. Convenient knockouts are provided together with ample space for wires and making connections, these features being especially noteworthy as regards the work of installing. An exclusive "locking off" device is furnished which effectually prevents operating the switch when placed in the "locked off" position. All cabinets are furnished with switches and cutouts mounted ready to install. The new line meets the latest requirements of the Hydro-Electric Power Commission of Ontario, and is approved by them. It is one of the results of the efforts of the Commission to render electrical installations non-hazardous, in which rapid strides are being made by the municipalities throughout the province.

Let Electrical Contracts Separately

Some months ago the American Institute of Architects passed a resolution recommending the practice of letting contracts for mechanical equipments such as heating, plumbing and electrical work separate from the general contract. The resolution of the Institute was worded as follows:

"Resolved, That the American Institute of Architects, in convention assembled, recommends to the members of our profession the adoption of the practice of direct letting of contracts for mechanical equipments such as heating apparatus, plumbing and electrical equipment. This recommendation is based on the conviction that direct letting of contracts as compared with sub-letting through general contractors affords the architect more certain selection of competent contractors and more efficient control of execution of work, and thereby insures a higher standard of work and, at the same time, serves more equitably the financial interest of both owner and contractor."

At the recent convention of the National Electrical Contractors' Association, the course of the Institute of Architects was approved in the following resolution:

"Resolved, That the National Electrical Contractors' Association of the United States, in convention assembled, concurs in the resolution adopted by the American Institute of Architects last December, at New Orleans, covering the segregation of plumbing, heating and electrical equipments, from building contracts; and that a copy of this resolution be sent to the Secretary of the American Institute of Architects."

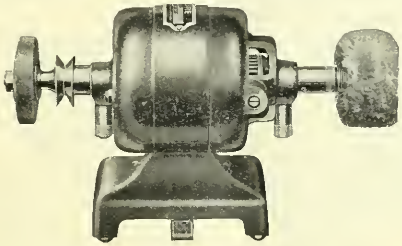
A New Morris Crane

An interesting new standard overhead crane has been introduced to the Canadian market by the Herbert Morris Crane & Hoist Company, Limited, a description of which is embodied in bulletin B9. Instead of running on the top of a rail, as is usual in overhead travelling cranes, this type is designed to run on the lower flange of two parallel I-beams. These may be existing roof beams, or special beams simply attached to the roof trusses; hence, a reduction in first-cost made possible by the elimination of the usual brackets.

J. H. Tucker & Company, manufacturers of electric light and power accessories, Birmingham, announce that H. M. Office of Works has just placed a contract with them for the supply during the next three years of single pole and double pole 5 and 10 amp. tumbler switches, and single pole 5 amp. two-way tumbler switches; these all to be of the company's well-known No. 20 positive action pattern. The switches are to be mounted on either white or black china bases, with fluted or plain brass, covers lined.

One Quarter h p. Universal Motor

The illustration herewith represents type D ¼ h.p. 110 volt universal Dumore motor for sale by the Canadian General Electric Company. This is a buffing motor that will run on any current, has good speed regulation and plenty of power, with which is also combined good workmanship



The Dumore Motor.

and attractive appearance. The motor is adapted for three speeds. It is finished in black enamel and equipped with emery wheel, buffer and pulley. This motor is especially designed for dentists and jewellers, but would also be extremely useful in hotels and restaurants.

W. H. Taylor, Limited, have incorporated as mechanical and electrical engineers and machinery manufacturers. Head office, Montreal; capital stock, $50,000.

La Compagnie Hydraulique de Portneuf, Limitee, has been incorporated with capital stock of $145,000 and head office at Saint Marc des Carrieres.

The Barnes & Kobert Manufacturing Company, pole line hardware and construction specialists, recently opened their new factory and office building in Milldale, Conn.

H. W. Knight & Bro., electric fixture manufacturers, of Toronto, announce the publication of their new catalogue on electric fixtures, which will be ready for distribution about October 15th. The catalogue, it is announced, covers a very wide range of designs.

Trade Publications

D. C. Motors—Bulletin 121, issued by the Robbins & Myers Company, describing and illustrating their type S steel frame direct current motors.

Monorail trains—Bulletin No. 48,700, issued by the Canadian General Electric Company, describing Sprague electric monorail trains, with illustrations.

Circuit Breakers—Pamphlet Y-487, issued by Canadian General Electric Company, Toronto, describing small capacity circuit breakers up to 300 amperes and up to 500 volts.

Steam Engines—Bulletin No. 128, issued by the Canadian Allis-Chalmers, Limited, Toronto, describing Chandler & Taylor steam engines built for direct connection to electric generators.

Hospital Call System—booklet issued by the Bryant Electric Company, Bridgeport, Conn., describing their silent call signal system for hospitals. This system is also adapted for service in hotels, offices, department stores, public buildings, etc.

Electric Drive for Flour Mills—booklet issued by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., describing and illustrating motors suitable for flour mill work. The same company have also issued a folder describing electrically-heated glue pots and glue cookers; and leaflets describing motor generator sets and electric drive for rubber calenders.

Electrical Equipment of Oil Wells—Bulletin 48013, issued by Canadian General Electric Company, describes electrical equipment of a large number of wells and gives tables of actual comparative operating costs for a considerable range of conditions showing excellent results obtained.

Curve Drawing Instruments—Leaflet Y-494, issued by Canadian General Electric Company. The instruments may be operated on alternating or direct current. The electrical element is of the solenoid type, simple and direct acting with gravity control. There are no make and break contacts.

Synchronous Converters—Bulletin No. 42,500, issued by the Canadian General Electric Company, illustrating and describing synchronous converting machines. The same company have issued bulletin F—a folder on Wheeler multiple mazda fixtures; also a folder dealing with types YKW and YKWC condulets.

Condensite—a booklet issued by the Essex Rubber Company, Trenton, N.J., describing a new substitute for rubber. It is claimed that for insulating work Condensite is far superior to hard rubber and shellac compounds, because of its heat-hesisting qualities, high dielectric strength, permanency of finish and sharp molding properties.

Tubular Steel Tripod.—Several novel features have been introduced into the construction of their folding tubular steel tripod, described in bulletin Y17, of the Herbert Morris Crane & Hoist Company. One feature which will appeal to contractors, structural engineers, stone workers and other users of this kind of lifting gear is the ability to fold up the tripod without removing any bolts or pins. A broad flange is provided on each foot to enable the tripod to carry a load on soft ground, and a square point gives a good grip on harder surfaces. Another new feature is the provision of a pulley at the top of the tripod by which a small rope can be used to haul up the heavy lifting block or to handle very light loads quickly. The one-ton capacity tripod is light enough for one man to carry on his shoulder.

Cutler-Hammer—Bulletins Nos. 4500, 4510, 4520 and 4530 describe the new Cutler-Hammer line of automatic machine tool controllers for use with shunt or compound-wound d.c. motors, adapted for constant or adjustable speed work, with or without interpoles. Increased output and lower cost of production is claimed for this automatic control owing to the ability of the operator to start and stop without leaving his normal position; the possibility of the foreman setting the control at the proper speed for a job and leaving the operator free to start and stop, but unable to change speed; and the dynamic brake, by which a tool that would otherwise run several seconds after the power is cut off, is brought to rest practically at once by the motor, which acts as a generator and stops the tool. Bulletin 4510 describes automatic machine tool controllers of the plain starting type; Bulletin No. 4520, those of the speed setting type, and Bulletin No. 4530, those of the speed regulating type. Bulletin No. 6753 describes double-pole diaphragm regulators for d.c. and a.c. motors; Bulletin No. 7131, full magnetic controllers; Bulletin 9125, secondary resistance starting rheostats for polyphase slip ring motors; Bulletin 9130, multiple-switch starters; Bulletin No. 9135 drum type starters; Bulletin No. 9155, drum reverse switches; Bulletin No. 9320, panel type speed regulators; Bulletin No. 9350, drum reversible crane controller; Bulletin No. 9355, hoist controllers; Bulletin No. 9359, rope operated drum reverse switch; Bulletins Nos. 9360 and 9365, speed regulators.

Current News and Notes

Brockville, Ont.

Ratepayers of the township of Kitley defeated a by-law to bonus the proposed Gananoque, Arnprior and Ottawa Railway to the amount of $25,000.

Charlottetown, P.E.I.

The Patriot has changed over from steam to electric power, and is now operated by two Wagner motors of three and ten h.p. respectively.

Cornwall, Ont.

A by-law was submitted on October 14th, extending the franchise of the Cornwall Street Railway, Light & Power Company, for twenty years.

Cow Bay, N.S.

The residents of Cow Bay are discussing the formation of a private exchange to connect with Halifax and Dartmouth.

Dauphin, Man.

A new 225 kw. vertical type Goldie & McCulloch engine has been installed in the power house here. The old units include 100 kw. and 65 kw. capacity, so that the total power available is approximately 400 kw.

Dawson, Y.T.

The City Council is planning to establish a municipal electric and telephone plant at an estimated cost of $165,000.

Duncan, B.C.

The delivery of machinery for the power house, the contract for which was let to a Glasgow firm. is being delayed on account of European conditions.

Dundalk, Ont.

The Pine River Light & Power Company have made an offer to this town to supply up to 200 h.p. at $40 per h.p., the town to pay a certain percentage of the cost of the transmission line.

Edmonton, Alta.

The Canadian Coal & Coke Company, Limited, have made an offer to the city of Edmonton to supply power at a rate varying from 1.6 cents per kw.h. down to ½ cent, depending on the amount taken. The company ask a contract for twenty-five or thirty years. It is the intention to erect a steam plant at the company's St. Albert colliery.

Embro, Ont.

The electric sub-station is nearing completion at this point. Power will be supplied from Beachville.

Fort William, Ont.

Net earnings of the Kaministiquia Power Company for the first ten months of their fiscal year totalled $229,751, as against $262,638 for the previous twelve months, so that, at the present rate, the company appears to be maintaining its earning capacity.

Galt, Ont.

The Dominion Railway Board met in Galt recently to consider the route of the Lake Erie & Northern Railway through this town.

The ornamental standards placed on the steps of High Park some time ago will now be mounted each with a nitrogen-filled tungsten lamp. This was the decision of the Parks Committee at their last public meeting.

Hamilton, Ont.

Plans are being discussed for the installation of a municipal telephone system. If arrangements can be made with the Bell Company for long distance service, it is said that the system will be built.

The Brantford and Hamilton Electric Railway Company have applied for an extension to their charter.

Inwood, Man.

Long distance telephone connection has been established between Inwood, Erinview and Winnipeg.

London, Ont.

Tenders will be called for two motor-generator sets to be used in connection with the electrification of the London and Port Stanley line.

It is understood that a number of hydro-electric commissions from various points in Ontario will combine in a request to the Provincial Government to inaugurate a municipal telephone system for the province.

Medicine Hat, Alta.

The Hudson Electric Company have secured contracts from the Maple Leaf Milling Company and the Redcliff Shoe Company for the supply and installation of electrical equipment.

Montreal, Que.

At the annual meting of the Sherbrooke Railway and Power Company, held in Montreal, Mr. S. L. Stafford, of Lennoxville, Que., was added to the Board, and retiring directors elected as follows: Messrs. Clarence J. McCuaig, president, Montreal; S. H. Ewing, vice-president, Montreal; Wm. Farwell, Sherbrooke, P.Q.; Frank Thompson, Montreal; D. R. McCuaig, Montreal; W. J. Thorold, London, Eng.; Grant Johnston, Montreal.

The engineering staff of the harbor board of Montreal, Que.. is engaged on plans for an electric railway to replace the present steam line which runs along the harbor front. The plan is to elevate the line. Construction work will not be commenced until next season.

Following out the programme of renewing the road-bed of the system ,the Montreal Tramways Company are reconstructing further portions of the line. Attention is particularly being given to important intersections, which are being relaid with 132 lb. rails. The new intersections allow for increased car clearance, permitting cars to pass each other in different directions without stopping. The work is being done under the direction of Mr. W. F. Graves, chief engineer.

Mr. G. E. Tanguay has been elected president and Mr. C. H. Branchaud vice-president of the Dorchester Electric Company, Quebec.

Messrs. Gray and Smith, Montreal, have obtained a contract for rebuilding the premises of the Bedford Manufacturing Company, P.Q., burned down six months ago and also constructing a dam on the Pike River. The company propose to generate their own power, and will purchase the necessary machinery after the building is constructed next spring. Messrs. Gray and Smith will install the necessary equipment for the electric lighting, including a 7 kw. 125 volt generator, distribution and lighting panels, etc.

Mr. J. J. Creelman, Montreal, having gone to the front, has resigned from the board of the Canadian British Insulated Company, Limited. His partner, Mr. A. Chase Casgrain, K.C., has been elected to fill the vacancy.

Owing to financial reasons, the improved street lighting scheme for St. Catherine Street, Montreal, has been abandoned for this year, but next season it is hoped to install the ornamental standards. Mr. Parent, superintendent of civic

lighting, is also getting out plans for improving the lighting of the public squares—at present poorly lighted. Mr. Parent suggests the removal of the wires and poles on Dominion Square, Phillips Square, Viger Square, and Lafontaine Park, and the installation of local systems of underground conduits. Ornamental light standards are proposed.

The 1914-15 programme of the Canadian Society of Civil Engineers includes the holding of meetings of the Electrical section, on November 19 and March 18. The meetings will be held in the Society's rooms, 176 Mansfield Street, Montreal. Mr. R. M. Wilson is chairman, and Mr. J. C. Smith, vice-chairman, of the section.

Nelson, B.C.

Mr. W. H. Stevens, superintendent of Dominion Government telephone and telegraph construction in British Columbia, states that work on the Dominion Government telephone line in this district will be commenced almost immediately. A new line will connect Nelson with Trail via Ymir, Salmo, Erie, Sayward and Fruitvale. The poles are being supplied by Mr. J. S. Deschamps, lumber merchant, Nelson, to the number of 1,900.

Niagara Falls, Ont.

The proceeds of the local electric railway system for one day, October 3rd, were donated to the Canadian Patriotic Fund, the fares being collected by the women of the town.

The local hydro-electric commission recently visited Hamilton to inspect the new lighting system there. It is probable a similar system will be installed in Niagara Falls.

Orillia, Ont.

During dredging operations on the Trent Valley Canal in the Ragged Rapids district, the water in the river will be lowered, by arrangement, so that the full power of the Orillia plant will not be available. The requirements of this town will be supplied from the Big Chute plant and the dredging contractors agree to pay the extra expense incurred.

Ottawa, Ont.

The first sod of the Ottawa and St. Lawrence Electric Railway was turned at Russell recently. The first division of the road is to be 119 miles in length and run from Ottawa to Morrisburg and on to Beaudette with a branch line from Metcalfe to Russell.

Owen Sound, Ont.

There seems to be a possibility that work will be commenced in the near future on the dry-dock to be built at this point. The operation of this plant will require some 700 h.p., which will be available from Eugenia Falls.

Peterborough, Ont.

The Peterborough Radial Railway Company are constructing a spur to connect with the C. P. R.

Port Arthur, Ont.

The Port Arthur Hydro-Electric Commission recommend that a by-law be submitted to the electors in January, authorizing the expenditure of $44,600 for a new sub-station at the pump house.

Runnymede, Ont.

The Ratepayers Association of this district are agitating for the operation of Sunday cars on the Toronto Suburban Railway Company's lines.

Regina, Sask.

The operation returns of the Regina Municipal Railway System for the week ending September 19th were as follows: Revenue, $3,052.80; passengers carried, 72,222. The corresponding figures for the week ending September 26th were $3,151.15 and 75,011.

Sault Ste. Marie, Ont.

On October 1st the Tagona Water & Light Company's property was taken over by the municipality and the plant will in future be operated as a municipal enterprise. The company has been operating on a twenty-year franchise, which expired on the above-mentioned date.

Stettler, Alta.

A by-law authorizing the expenditure of $5,000 on electrical equipment was carried.

St. John, N.B.

The St. John Street Railway Company have started work on the extension of their line along Marsh Road.

St. Thomas. Ont.

The monthly record of the city's municipal street railway income shows increases over the corresponding figures of a year ago.

Toronto, Ont.

Mayor Hocken is authority for the statement that negotiations regarding the purchase of the Toronto Street Railway System are postponed for the present at least.

The Hydro-Electric Power Commission have recommended Mr. J. Shields as head of the Electrical Inspection Department of the city of Toronto.

The Ontario Railway and Municipal Board has ordered that the Toronto Railway Company shall complete the line on Teraulay Street between Agnes and College by the first of November.

The City Council has authorized the further issue of bonds by the local Hydro-Electric Commission to the extent of $1,000,000. The Commission asked to be allowed to raise $2,000,000. The greater part of the $1,000,000 has already been expended in necessary extensions.

The Board of Control are considering the extension of the Bloor Street car line in West Toronto. The work will probably be carried on by day labor.

An application of the Toronto Railway Company to the Ontario Railway and Municipal Board for permission to lay a siding along the west side of Church Street, close to the company's offices, for the purpose of collecting the fare boxes from the passing cars, has been refused.

Arrangements have been made between the city and the Toronto Railway Company for the reconstruction of the track allowance on College Street between Spadina and Lansdowne Avenues, and work between Spadina and Bathurst will be completed this year.

Municipalities north of this city will vote on October 19, on expenditures for hydro-radials as follows:—Markham, $48,762; Newmarket, $266,986; Pickering, $578,115; Williamsburg, $2,750; Twp. of Scarboro, $565,714; Twp. of Markham, $803,939.

Vancouver, B.C.

An order has been received by the Canada Wire & Cable Company (agents, Macdonald Marpole Company, Vancouver) from the West Kootenay Power Company, for 18½ miles of bare hard drawn copper wire.

The Electrical Repair Company maintain a twenty-four hour service. This is a development in the electrical contracting field that has met with considerable favor with the public, and is proving generally profitable to the contractors themselves.

The effect of the present trade depression in Vancouver is shown by the fact that some 6,000,000 less fares have been collected during 1913 than over a similar period a year ago. This is partly accounted for, however, by an increase in the fare.

Winnipeg. Man.

The Canadian Westinghouse Company have been awarded a contract by the Board of Control for six oil circuit breakers electrically operated. These are to be installed at the municipal generating plant at Point du Bois.

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Generation, Transmission and Application of Electricity

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Utility Valuations

No more difficult problem confronts the engineer to-day than that of placing a correct valuation on this or that property required for purchase, expropriation or other purpose. This difficulty is amply evidenced in the wide variation in the figures of different valuations on the same property. That the matter is one of very vital importance in Canada, however, can be well understood when we consider the numerous present-day encroachments of municipal ownership on private utility enterprises and the unfavorable financial situation the private owner finds himself in if forced to accept an inaccurate and inequitably considered estimate of his property.

Inaccurate estimates in the past, let us hope, have been the result of poor judgment and insufficient information rather than with any deliberate intent. Such estimates are, of course, most likely to err on the side of under-valuation, because a large number of elements of which the valuator has no practical experience have entered into the original cost of the plant. The cost of the same plant in two different localities, constructed in different years, or completed over different periods, will vary greatly. Hence, the work of the valuator calls for combined practical, technical and accounting knowledge of the highest order, together with the exercise of good general common sense.

Down in Ohio State they have a public utilities commission that regulates the rates, etc., of the public utility companies. To this end it was necessary that the commissioners have a first-hand knowledge of the value of each property; hence the problem of establishing a proper basis of valuation at once arose. This problem has been solved, for Ohio at least, by the appointment of a committee on valuation, who have now submitted a report outlining the "Principles which it believes to be sound and practical, as applied to the 'Reproduction cost new, less depreciation,' method of valuing a public utility." We reproduce copious extracts from this report on other pages of this issue, believing this matter will be found of value to a large number of readers. As indicating the thoroughness with which the committee appear to have done their work, we may mention the single item of interest on capital "During construction." This item, often forgotten in the estimates, is of considerable importance, especially if the work of construction is much delayed—as it frequently is—beyond the date set for completion.

Grounding Transformers

Once more the necessity of grounding the secondary side of distributing transformers has been brought home to us in the tragic death of a private resident of St. Catharines, as the apparent result of a short circuit between the primary service wires and the low voltage lines entering the house. After hearing the evidence on both sides, the coroner's jury's finding was that death would not have occurred had the system been grounded as modern practice demands.

In a matter of this sort, it is of course very difficult to lay the blame on the most faulty party. One thing is certain, however,—this man's death is the direct result of somebody's neglect to do his duty. The necessity of grounding is recognized beyond question. Why then was the system not grounded?

On the face of it, the fault would appear to rest with our Governments. If the laws of Ontario or any other Canadian province do not make it sufficiently clear that electric distributing systems shall and must be grounded, then blame for this man's death lies at their door. Again, if the law is defined but not enforced, it is equally difficult to see how the Government can shift the blame. The very fact that a government does not take steps to enforce laws it has made is surely sufficient justification for any citizen believing that this act is a dead letter, and if any of the parties concerned in the St. Catharines tragedy have been acting on this supposition, it is difficult to see how they can be punished, or indeed greatly blamed, at this time.

The situation is one of those, apparently, where it is perfectly plain what ought to be done, but not so plain who ought to do it. The people who understand the situation best are for the most part financially interested and so, naturally, will not, except under pressure, incur heavy expenses and endanger their yearly financial statement for purely humanitarian reasons. On the other hand, of the people who make our laws there are comparatively few who are in touch with matters of such a technical nature.

We would suggest that, in the absence of a Canadian Society of Electrical Engineers, this is a matter for the attention of the electrical section of the Canadian Society of Civil Engineers or for the local sections of the A. I. E. E., and that either, or both, of these might use their influence to advantage. The vital importance of grounding all secondary circuits in distribution work should be brought prominently and persistently before both local and Dominion houses, until such time as present defective installations are corrected, and the lives of our citizens receive, to the full, such protection as the present state of the science of electrical distribution can give. Even then some accidents must occur, for there is still much to learn. But such a measure of protection as can be given a private consumer he should be in a position, backed by the law of the land, to demand.

What are the Facts?

The free exportation of our nickel ore is making it easy for Germany to obtain a supply of this war necessity for use in manufacturing fire-arms and ammunition. This statement is being heard on all sides. We are sending troops to overpower the Kaiser, and at the same time handing him, with our compliments, the weapons with which to defend himself. The fact that nickel is contraband of war is not sufficient excuse for allowing this free exportation, as, in spite of all the vigilance of the British navy, a certain amount of smuggling must get by, where the demand is so insistent and the chances of profits so alluring. The exportation of nickel from Canada should immediately be limited to the actual industrial necessities of friendly customers, as nearly as this can be gauged, and an error on the side of under-exportation, even for this purpose, would be a matter of comparative indifference at the present moment.

Rumors are afloat that powerful financial interests are responsible for the inactivity of our governments, and even that the influence of certain of these men is rendered all the more effective in that they themselves occupy prominent government positions. This is a matter that will be investigated. It is also said that the famous Krupps, the prime source of German effectiveness today, are heavy shareholders in and actually control the majority of the stock of one, at least, of the more powerful Canadian nickel mining companies. Think of it—under our very nose the German Emperor carrying on, undisturbed, mining operations which in turn feed his foundrys, to turn out still more powerful guns and explosives to be used to destroy our own brothers in the field. Is our Government doing everything to stop it? If there is anything in these reports, we and all other Canadians **want to know it at once.**

"Money" for Red Cross Society

The Canadian Red Cross Society have issued literature calling attention to their work, and pointing out the necessity for further subscriptions if the work already undertaken is to be developed to its highest point of usefulness. Included in the literature is a booklet entitled "Suggestions for Work," which points out lines along which supplies are most urgently needed. Another pamphlet explains the rules of the society. There is also included an article by Col. G. Sterling Ryerson on the Canadian contribution to the medical services in the great European war. Speaking of the Canadian contingent, Col. Ryerson concludes as follows:—

"It is our duty as well as our privilege to provide for the sick and wounded of this contingent all comforts which may be possible either directly through our own society or indirectly through the British Red Cross Society. To accomplish this we must have first money, with which to purchase the necessary articles which cannot be made at home, to contribute cash to wounded and sick soldiers and to pay the running expenses. Therefore, give as your heart dictates. The widow's mite and the millionaire's cheque are equally welcome, and will be faithfully applied.

"Money and goods should be sent to the Treasurer, Canadian Red Cross Central Committee, 77 King Street East, Toronto, or to the local committees of your district."

Openings for Canadian Trade

The Canadian Department of Trade & Commerce, in their weekly reports, continue to draw attention to the increasing number of openings for Canadian trade in different parts of the world, as the paralyzed condition of German and Austrian business becomes more fully recognized. The issue of October 19th contains letters from the trade commissioners in South Africa, Australia, New Zealand, West Indies, Trinidad, and other points, all of which are in the same strain, indicating that one of the strongest weapons against Germany and Austria at the present time is in cutting off not only their present trade, but the possibility of renewing old relationships when the war is over. As indicating the fields now thrown open to Canadian manufacturers, we mention the following:

South Africa

During the year 1913, out of a total importation of wire and cable of $375,000, Germany supplied equipment to the amount of $350,000.

Last year's imports of electrical machinery amounted to $2,255,000, of which Germany's share was more than half, being valued at $1,260,000.

New Zealand

One of the larger items of New Zealand's import trade from Germany is motors and auxiliary electrical materials, to the amount of $350,000.

British West Indies

Electrical machinery to the extent of $30,000 was imported from Germany during the past year.

The Horse-Power Required per Capita in Cities

By H. E. M. Kensit, Mem. Am. I. E. E.

Engineers frequently require for estimating purposes to take a figure for the maximum h.p. likely to be required for electric light and power supply in a given city at some future point in its growth and population.

The writer recently had occasion to obtain direct from the officials of a number of medium-sized Canadian cities, particulars as to the maximum h.p. developed at the municipal electric light and power works and the estimated population at the same time. Cities were chosen for the enquiry where there were no unusual conditions or circumstances, where there was no alternative or competitive supply and possessing about an average number of miscellaneous industries.

The generally accepted figure for such an estimate is one-tenth of a horse-power per capita and the result of this careful enquiry so closely confirms this figure as an average result that it is thought the particulars shown on the accompanying table may be of interest to other engineers.

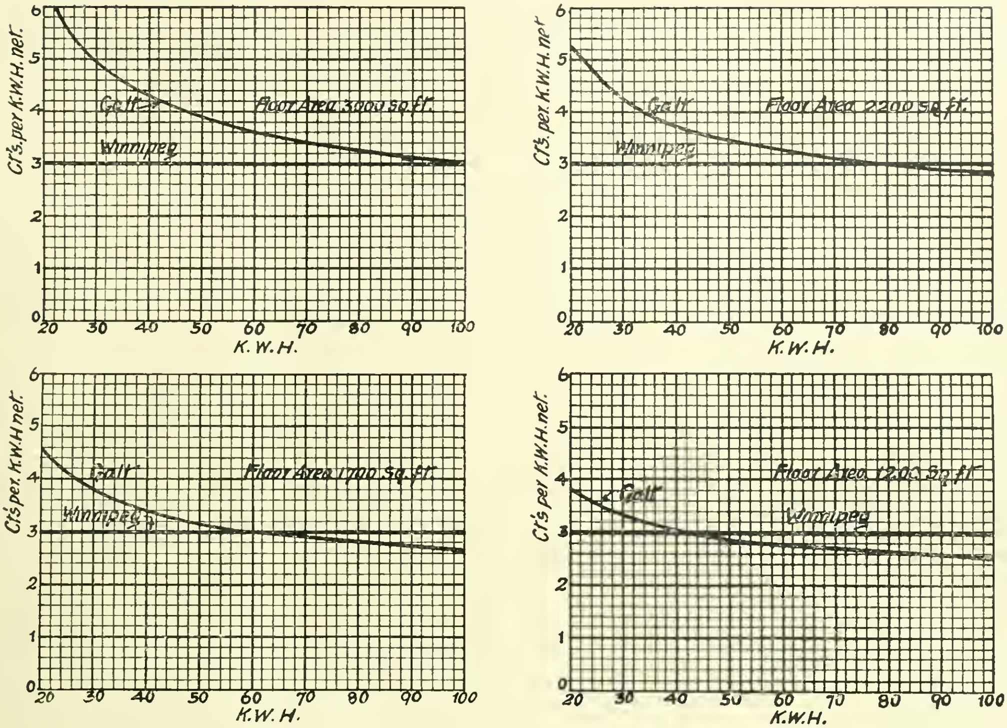
The figures given are for the actual maximum load on the central station and do not include reserve plant or private power installations.

Electric Power Demand
Peak Load on Municipal Power Plants.

	Location	Population 1913	Peak Load in H.P. Lighting	Power	Street Railway	Total	H.P. per Capita
A	West	60,000	2,680	1,470	3,080	7,230	0.120
B	"	42,000	1,940	670	1,070	3,680	0.090
C	"	75,000	5,100		3,150	8,250	0.110
D	"	29,000	2,500		600	3,100	0.107
E	East	46,000				6,000	0.130
F	West	12,000				820	0.070
G	"	12,000				1,070	0.089
						Average ...	0.102

Lowest Rates in Canada

In our September 15th issue, under the heading "Lowest Rates in Canada," we published, along with a few comparative figures, the new rates just established by the Hydro-electric Power Commission of Ontario in Galt. It is plain, however, as shown in a Winnipeg communication printed below, that Galt has a strong competitor and that the title is not going by default. As shown by the explanation in the attached article, and still more clearly by the accompanying curves, the small consumer in Winnipeg has decidedly the best of the argument. For all consumption up to 40 kw.h.



Showing comparative rates Galt, Ont., and Winnipeg, Man.

per month, the Winnipeg rate is the lowest, and with the larger floor areas it is lower up to 100 kw.h. As it is probably safe to say that the majority of customers who use electric current for lighting purposes use less than 40 kw.h. per month, it follows that, in the majority of cases, Winnipeg rates are lower. If the customer's consumption should get as low as 10 kw.h., the difference is even more noticeable, as, in this case, the Galt rate (say 1,000 ft. floor space) is 27 cents plus 22½ cents, a total of 49½ cents, as against 30 cents in Winnipeg. If a man with a 3,000 ft. floor space economizes to the extent of keeping his consumption down to 10 kw.h., the Galt rate would be 81 plus 22½ or $1.03½, as against 30 cents in Winnipeg. It would appear, therefore, that on the average account, the advantage is with the Winnipeg citizen. The protest mentioned above reads as follows:—

"Winnipeg challenges the statement made in the 'Electrical News' of September 15th that Galt, Ontario, enjoys the lowest lighting rates in Canada.

"Since January, 1912, the Winnipeg rate for domestic lighting has been 3 1-3c. per kw.h., with 10 per cent. discount for prompt payment. This is a straight meter rate there being no area charge and, on this account, it is difficult to obtain a mutually acceptable basis of comparison. It is, however, possible to obtain approximately accurate figures on average floor area and monthly consumption, as was done by the City of Winnipeg in 1912. Assuming first, conditions most favorable to the Galt rate, let us suppose the floor area of the average private residence to be 1,000 sq. ft. or less. The average area charges, under these conditions, would be 27c. As the difference between the meter rates of Galt and Winnipeg is ¾c. per kw.h. net, it follows, where the monthly consumption is above 36 kw.h., the Galt rate is lower and, when less than 36 kw.h., the Winnipeg rate is lower. The question, therefore, is whether this figure of 36 kw.h. is high or low. We believe that it is sufficiently accurate to entitle the City of Winnipeg to a claim to at least as good a domestic lighting rate as any other Canadian city. This claim is still further fortified by actual tests, which show averages of 1,700 sq. ft. and 45 kw.h. for floor area and consumption respectively. With a 1,700 sq. ft. residence, the fixed charges being 40c. per month net, the critical point is 61 kw.h. per month or 16 kw.h. more than the average. The Winnipeg rate, therefore, for a residence of this size, would in all probability be less than the Galt rate.

"The difference between these rates is illustrated graphically in curves 1, 2, 3, 4. In curve 1 with a floor area of 3,000 sq. ft., the critical point is 108 kw.h., in curve 2 it is 80 kw.h., in curve 3 it is 61 kw.h., in curve 4 it is 43 kw.h. Winnipeg's claim is that the consumption indicated by the critical points on these curves is in excess of the average consumption, thus proving their rate to be the lower. This claim is of course open to dispute, but, in any case, it must be admitted that the policy of municipal ownership of public utilities adopted by the citizens of Winnipeg has proved a wise one, in so far as it has resulted in a reduction of rates from 10 cents to 3 1-3 cents in the last three years.

"The Winnipeg commercial lighting rate is specially low, being 3 1-3c. per kw.h., with 20 per cent. discount for prompt payment, and additional wholesale discounts from 20 per cent. to 60 per cent., when the bill is over $25.00. This net rate has at times worked out as low as 1¼c.

"The Winnipeg rate for heating is 1c. per kw.h. with 10 per cent. discount. The power plant is graduated and is subject to wholesale and prompt payment discounts, and a net rate of ½c. per kw.h. has been obtained by large users."

The Cost of Electricity at the Source

[The June 1st issue of the Electrical News contained an article by Mr. H. M. Hobart on "The Cost of Electricity at the Source," which had been presented shortly before at a meeting of the American Institute of Electrical Engineers. In this article Mr. Hobart places the cost of a steam turbo-generating plant of 100,000 kw. capacity, 5 units of 20,000 kw. each, at $35 per kw. Where a plant is to be located in or near a large city, this cost is placed at $40, to make allowance for increased outlay on land and buildings. We print below the discussion on this paper, which has just been published in the Proceedings of the society. For the most part, Mr. Hobart's cost figures are criticized as being too low.—Editor].

"The Cost of Electricity at the Source"

J. W. Lieb, Jr.: I am sure that under the conditions obtaining in our larger cities the figure given by the author, of $35 per kilowatt of capacity, will not cover the real estate and buildings of a character to satisfy local conditions. The sum of $35, even if otherwise adequate, which I doubt, would allow the merest shell of a building rather than such a structure as it would be necessary to provide to house a plant of the capacity indicated by the author.

H. R. Summerhayes: I ask Mr. Hobart how many days' coal storage is provided for under his plan. In these days of coal strikes and interruptions to transportation it seems necessary to provide a large acreage of land to store a large amount of coal. Such a station ought to require a large area for that purpose.

H. W. Buck: There is one advantage which the steam plant has in this comparison. As a rule, the water power plant is many miles from the point at which the power is applied, and the cost of transmission lines, sub-stations, etc., must be added. On the other hand, the steam plant, as a rule, can be located practically at will, and as near as possible to the centre of load. This also applies to operating costs on the transmission system, which the steam plant will not have to so great an extent.

Frederick A. Scheffler: I hope that the author of this paper will be more specific in giving us exact data as to how he arrives at $35 per kilowatt for the cost of constructing a complete 100,000-kw. station.

I would like to know what size boiler units he proposes to use, whether he will use steam turbines, and if so, what size units, working steam pressure, superheaters, if any, and degree of superheat, at what rating the boilers will be operated and what kind of stokers will be used, whether underfeed or otherwise, and whether the cost covers economizers.

I have in mind a plant which is being constructed in the West at the present time, of an ultimate capacity of 120,000 kw. The company which is building this plant feels that if it can construct the station, using six 20,000-kw. turbines and twelve 2400-h.p. (nominal rating) boiler units, with superheaters for 200 deg., and operating the boilers at 200 per cent. of rating when necessary, and the cost does not exceed $55 per kilowatt complete, it will have a very reasonable and inexpensive station, considering its construction, which is to be of the very best throughout.

H. L. Wallau: I have only one criticism to make of this paper, and that is the figure of $35 per kilowatt. That figure has been qualified in this discussion, and it has been qualified as presented by Mr. Hobart. However, in a city such as Cleveland is, the tendency will be for the engineers of the municipality to say, just as soon as a figure of $35 per kilowatt is published in an Institute paper, that it must be pretty close to the actual cost. Apparently the way they figure cost in Cleveland in a municipal undertaking, is to take the figures, for instance, published in the Institute Proceedings for a 300,000-kw. plant, and say, "If they can do that in a 300,000-kw. plant we ought to be able to do practically that in our 15,000-kw. plant," and as a result they have published a schedule of rates, with a maximum rate of three cents and a minimum rate of one cent. I believe on last Tuesday they got ready to pass a maximum rate ordinance of three cents, to which they expect us to conform. I think for these reasons, when a statement is made, and a figure is pubished, that it should be carefully qualified, because the tendency towards municipal ownership is growing rapidly in this country, and the analysts are, I believe, making some very grave errors in their calculations.

H. B. Alverson: The load factors given are too high for the usual existing conditions, and while it may not be the intention in the paper to give exact figures, I believe the load factor which will occur in practice will be nearer to 35 or 40 per cent. than to 50 per cent. In such cases the cost per kilowatt-hour would rise somewhat higher in proportion than the figures given. Without going into the calculation of the proportion of costs based on the load factor, I think the average experience is that it is very much higher than that which is given in the paper.

O. K. Harlan: Regarding the matter of depreciation, it might be of interest to note that a few weeks ago, before the American Society of Heating and Ventilating Engineers, a paper was presented giving something of the life history of quite a number of the old electric lighting steam-driven plants in this city, and the matter of depreciation was dealt with in that paper. It traces the history of the very earliest installations, including the first steam-driven electric dynamos which were operated in the city. One of the old ones is in the Mills building, and a number of others are downtown, near it. The depreciation was shown to be quite a variable factor; of course, some generators will deteriorate faster than others, and the matter of economy and efficiency is quite an item also; that is to say, some of the more recent generators may be of so much higher efficiency that it is worth while to discard a really good working machine in order to put in a more modern machine of higher efficiency. However, this paper shows that a number of these earlier plants have had a useful life of twenty years; some are really working today, which were installed twenty years ago—but the matter of depreciation, while it is a very interesting subject, is really somewhat intricate, and there are a good many factors entering into the final decision.

H. C. Abell: If Mr. Hobart means the $35 to cover the cost of machinery, water facilites for a plant of that size, storage requirements, working capital, supplies, cost of financing the undertaking, and all the incidental expense, I think unquestionably he used the wrong multiplying factor to arrive at the figure given, which I consider too low.

Another thing which attracts one's attention is the five per cent. interest figure used by Mr. Hobart. I do not know of any money source which could be induced to provide funds for a power-generating plant on a five per cent. basis.

I suppose amortization placed at 4.6 per cent. is a depreciation fund, for a power plant is usually not amortized, but is a continuous business where the owners have to provide funds continuously for new construction after the plant once starts. Amortization is entirely different from depreciation; the two terms should not be confounded.

A. H. Kruesi: With regard to depreciation, I believe obsolescence often cuts a much larger figure than depreciation due to wear and tear. I am associated with a large steam-turbine power plant built eleven years ago. The stokers and

their auxiliary equipment are now being scrapped because they are obsolete, though not worn-out. A number of boilers installed seven years ago are also being scrapped because they are of a type no longer manufactured and the allowable working pressure has been reduced, so that they have become unsuitable to their purpose. The entire switching equipment is being replaced after eleven years' use because the plant has grown and it is no longer adequate for the amount of power behind it. I agree with the criticism of Mr. Hobart's paper, on the score of his capital cost charges. I do not see how they could possibly be figured at less than 15 per cent.

V. Karapetoff: Mr. Hobart's paper has been criticised on account of the specific numerical data given in it. I know from certain experiences in court testimony that outsiders are only too liable to ascribe to the Institute any data published in its Proceedings, in spite of the well-known fact that the Institute is not responsible for opinions expressed by its individual members. To me, personally, Mr. Hobart's paper is exceedingly interesting and instructive in giving a concrete method of calculation. If he had chosen to use letters, instead of numerical values, I am afraid the paper would be exceedingly difficult to follow, but then it would have been of greater general interest, as any one could substitute numerical values for his particular problem and the above criticism would be obviated.

I was surprised at the statement that the outlay for the turbo-generators, cables, exciters, switch gear, etc., amounts to only 30 per cent. of the total cost of the generating station. It seems to me that engineers in this country ought to be more interested in the Thury system of generation, which, so far, has been mainly applied to hydro-electric stations, but lately was chosen in London for underground distribution from a steam plant. The principal advantage of the Thury system is that not only the cables themselves cost less, but also the generating station is lower in cost; while the generators themselves are more expensive, the cost of auxiliary apparatus is much lower. If one goes into a station like the Northwestern station in Chicago, it is the auxiliaries which strikes one's eye, and it is the auxiliaries which occupy the most room and apparently seem to cost the most.

G. L. Knight (by letter): The author of this paper states that a 100,000-kw. steam station, consisting of five 20,000-kw., 60-cycle, 1800-rev. per min., three-phase turbo-generators, together with all the apparatus, both steam and electric, required for the operation of such a plant, can be built in this country for an over-all charge of $35 per kilowatt.

This paper, being presented before the A.I.E.E., presupposes in the absence of contrary statement that the figures given represent American practice, but in replying to the discussion on his paper in the meeting of February 26, Mr. Hobart defended his estimate by the following figures taken from estimates of plants constructed in England:

	per kw.
Turbo-generators, including exciters and switch gear	$10.50
Steam raising plant	8.50
Condensing equipment	5.00
Building	8.00
	$32.00

This leaves only $3.00 for the rest of the charges, which must include land, general engineering and construction expense other than that included in the items as given, also all overhead charges during the construction period.

In place of the figures set down by Mr. Hobart, I would give the following as minimum values, and while they will vary greatly according to the conditions a plant must meet, the total cost per kilowatt will be often much nearer $75.00 than the figure given.

Building		$10.00	
Turbo-generators, including exciters	$12.50		
Switch gear	3.00		
		15.50	
Steam plant			
Boilers	6.00		
Stokers	2.50		
Flues and piping	2.00		
Coal and ash handling equipment	1.50		
		12.00	
Condensing equipment			
Condensers and pumps	3.00		
Condensing tunnels	2.00		
		5.00	
			42.50
Engineering, drawings, supervision and other overhead expenses, 15 per cent.			6.35
Allowance for piecemeal construction and contingencies, 15 per cent.			6.35
			$55.20

To those of us in the employ of public service companies this paper seems at least ill-advised. Regulating bodies and the advocates of municipal ownership are constantly challenging our capital costs, and when a company's books show a cost of $50 to $75 per kilowatt for a new plant (and older ones will be even higher), papers such as this are quoted in attempting to prove such costs excessive.

In such cases it is assumed, by those who do not know the Institute rule, that having accepted such a paper for presentation at a meeting, the Institute must have passed on it as being reasonable.

I think Mr. Hobart should have stated that his whole case rested on English figures, and I am inclined to believe that even in England no plant has ever been completed which, when all charges were accounted for, came within his figure at $35 per kilowatt.

Frederick G. Strong (by letter): Permit me to say a word in behalf of our water powers; they seem to have very few friends among those who have discussed Mr. Hobart's paper.

I remember a paper by Dr. Emory, in which the general statement was made that where the cost of water power development exceeded $150 per horse power a steam-driven plant would be advisable where good coal could be obtained at about $4 per ton. We have heard, periodically, that a slight increase in efficiency or a slight decrease in the cost of steam-driven machinery, would cause the water powers to be abandoned, or left undeveloped.

We have seen a marked increase in steam efficiency in the past ten years and a marked decrease in cost per kilowatt, due to increased size of units and increased speed and activity of material, but the water powers are still in use. None have been abandoned, and plans are being formulated for the development of many more.

The theory that water powers should be abandoned, or left undeveloped when they show a greater cost than equivalent steam-driven stations, does not seem correct, and I believe the time is not far distant when we will develop every available water power, to the end that the coal supply may be conserved as much as possible.

Undoubtedly the water powers at Holyoke, and Lowell, and Lawrence, and Manchester have cost far more than equivalent steam power, but if those investments were annihilated, does anyone believe that the power would be left undeveloped?

In the energy of falling water Nature has not by any

means given us something for nothing, but it is doubtful if we may expect a nearer approach.

H. M. Hobart (by letter): I shall deal with the contributions to the discussion of my paper in the order in which they were made.

As to the first comments which were made by Mr. Lieb, it would appear that his intention is to supplement my paper and emphasize the importance that it should not be construed as applying to stations located in or near large cities. It was clearly shown in my paper that I referred to a station located with especial reference to low cost of land, abundance of circulating water and low price for fuel. This necessarily locates the station at some situation where architectural effect is absolutely out of place. In the recent report made to the London County Council by Messrs. Merz and McLellan, it is pointed out that in modern plants "the power house tends more and more to become a metal structure for housing the machinery rather than an actual building in the usual sense." The savings which can be effected under the conditions which I describe for my plant are inapplicable to a power house located in our larger cities, and I am glad that Mr. Lieb took the occasion to emphasize this point. Furthermore, in city plants supplying electricity for all sorts of purposes to a large community there must be large investments for duplicate switch equipments and for supplying large numbers of feeders. This inevitably runs up the cost, as it does also the need for economizers, which are justifiable under these circumstances, since the price of fuel is relatively high. It was expressly stated in my paper that no outlay for transformers was included, and further, that the estimates related to 60-cycle generating sets. These sets were only five in number, of the most modern type, and were for a rated speed of 1800 rev. per min. In city stations it is often necessary to supply, not only 60-cycle electricity, but also 25-cycle electricity, and furthermore, the stations will usually be found to be equipped with more than one size of generator. Moreover, the average rating of all the generators in the station is usually much below that of the 20,000-kv.a. units on which I based my estimates, and they are driven at lower speeds, as a consequence of which they are larger, more expensive in first cost, more wasteful of fuel, and a greater outlay is required for the attendance upon them. When a given aggregate output is delivered from ten small units, as against five large units, the outlay for wages in the station is decidedly greater. Mr. Lieb considers that the real estate and buildings for a station in our larger cities would not be covered by $35 per kilowatt of capacity. Taking it at $40, and including an appropriate allowance for the increased outlay for switch gear and for economizers and transformers, then, with an allowance for engineering and contingencies amounting to 10 per cent. of the total, we arrive at over twice the capital outlay per kilowatt installed that would have been necessary on the same scale of prices for a station complying with the conditions set forth in my paper.

In the matter of Mr. Summerhayes's suggestion that in these days of coal strikes and interruptions to transportation, it seems necessary to provide a large acreage of land to store a large amount of coal, and I would point out that with such locations as that clearly contemplated in my paper, the land could not reasonably be taken as costing more than $200 per acre. On this basis, the outlay for a site of 50 acres would only amount to $10,000, which is less than three-tenths of one per cent. of the total capital outlay for this 100,000-kw. generating station. Mr. Summerhayes evidently also had in mind the conditions in large cities, far away from the mines, and I quite agree with him that under these conditions the point which he mentions would be one requiring careful attention.

I fully agree with the point which Mr. Buck makes that the steam plant has the advantage over the waterpower plant, that it may sometimes be located quite near to the centre of the load, thus minimizing the costs in transmitting the electricity to the customers. However, I dealt with "The Cost of Electricity at the Source" and pointed out that by locating a generating station where the conditions as regards fuel and water supply and cost of land are favorable, electricity can be manufactured for a low price and that industries, the cost of whose product depends largely on the outlay for electricity, would be well advised to realize and take advantage of such possibilities.

I am pleased to be able to comply with Mr. Scheffler's request for more specific data as to how I arrive at the cost of the complete 100,000 kw. station. This is set forth in the following table:

I.—Turbo-generators, exciters, cables and switch gear, but exclusive of step-up transformers..	$10.50
II.—Boilers, superheaters, furnaces, and stokers, but exclusive of economizers, pumps and piping ...	9.00
III.—Condensers, exclusive of pumps, piping and tunnels ...	2.50
IV.—Pumps, piping, tunnels, valves and traps	1.50
V.—Land and all buildings and structures, including machinery foundations, stacks, bunkers and conveyors ...	8.00
VI.—Engineering and contingencies (10 per cent.) ..	3.50
Total cost per kilowatt ...	$35.00

Mr. Wallau also points out how important it is that the conditions under which such figures can be reached should be clearly stated. I welcome Mr. Wallau's assistance in helping me to point out the distinction between plants of the size and character which I am discussing in the paper, and such relatively small plants as those to which he refers.

Regarding Mr. Alverson's comments, I show in my paper the cost of electricity for all load factors down to 0.30. It may, however, be of interest to point out that the application of electricity to chemical and certain other industries often permits of much higher load factors than have, until recently, been at all customary, and that decided commercial importance attaches to a knowledge of the costs under such conditions of high load factor. Such applications are usually only practicable when the cost of electricity is very low, and in the near future we shall certainly see such industries purposely located where conditions are favorable as regards plentifulness of water and low cost of fuel and land.

Mr. Harlan makes some interesting suggestions. He calls attention to 20 years as a reasonable life for electrical machinery in many cases. My figures for the investment cost are based on an equivalent life of 15 years.

The next two contributors to the discussion of my paper were Messrs. Abell and Kruesi. It is the opinion of both of these gentlemen that my investment costs are a little too low, Mr. Abell's criticism being that funds can rarely be obtained for a power generating plant at so low a rate of interest as five per cent., and Mr. Kruesi emphasizing the importance of the obsolescence factor. All engineers realize the difficulty of equitably assessing the investment costs, owing to the impossibility of predetermining the obsolescence factor and the great difference in the financial standing of companies embarking upon electricity supply enterprises. I believe that the figures on which I have based the annual investment charges are representative for the case under discussion, but it is obviously important to apply a safety factor which should be inversely proportional to the financial standing of the companies.

I am interested in Prof. Karapetoff's suggestion that my paper would have been of greater general interest had I chosen to employ letters instead of numerical values. My own experience is, however, that the paper would not have attracted attention. It is my experience that papers rarely fulfil any useful mission unless they stimulate discussion.

Mr. Knight puts forward an interesting alternative estimate, regarding which I should like to offer the following

comments. For "turbo-generators, including exciters," Mr. Knight allows $12.50 per kilowatt. For "turbo-generators, exciters, cables, and switch gear" I gave the figure of $10.50 per kilowatt. For a city station with its more elaborate provision for switch gear and its large number of feeders, the equivalent allowance would be $11.50 per kilowatt were five 20,000-kw., 60-cycle, 1800-rev. per min., unity power factor turbo-generators to constitute the equipment. If we turn to page 981 of Messrs. Stott, Pigott and Gorsuch's paper entitled "Present Status of Prime Movers," and published in the A.I.E.E. Proceedings for June, 1914, we find $7.50 per kilowatt taken as the "average" cost of a 20,000-kw., 60-cycle, 1800-rev. per min. turbo-generator. This would seem to indicate that my figures are conservative for large plants favorably located.

As regards the other items, Mr. Knight's estimates do not differ materially from my own, except that he allows 30 per cent. for "engineering, drawings, supervision and other overhead expenses, piece-meal construction and contingencies" as against my allowance of 10 per cent. for "engineering and contingencies." I quite agree that such items may run up to large values and that for each case they must be separately considered.

The last contribution to the discussion is by Mr. Strong and is to the effect that waterpower should—and will—be developed irrespective of the relative capital and operating costs of the investment, as compared with the equivalent undertaking employing turbo-driven generators. One of the objects which I had in view in writing my paper was to call attention to the liability of misapplication of capital. Large amounts are often invested in waterpower developments running much above $100 per kilowatt installed and in some cases it could be demonstrated that the greater capital charges more than offset the elimination of fuel costs. Often a steam-turbine station at a favorable site would represent a better investment. But there is the liability that any consideration of a steam-turbine station will be dismissed after very superficial calculations, in the mistaken belief that the investment for the steam station will necessarily be excessive. Fifteen years ago (before the advent of the steam turbine) the case was much more favorable for waterpower as compared with steam.

It is equally desirable to call attention to the related danger that the high efficiency of the internal combustion engine will attract capital, notwithstanding that the generating sets alone will cost at least $60 per kilowatt and even the fuel cost will be as great with the internal-combustion engine as with the steam turbine with oil at 2½ cents per gallon and coal at $3.00 per ton. The outlay for attendance, lubrication, and repairs will be much greater with the internal combustion installation. The misdirection of capital in this way would be checked by the more general realization of the low investment cost associated with steam turbines.

In conclusion I should like to take the opportunity to discuss briefly the factors which have contributed to the rapid progress which has been made toward decreased cost of electricity. There has been of recent years rapid progress in the direction of increased efficiency of prime movers. This has been accelerated by the use of individual sets of very large capacity. Not only have these sets relatively high efficiencies, but the investment cost per kilowatt is relatively low. It is well known that the steam consumption of modern steam turbines is much less than ten years ago, consequently a given capacity of steam raising and condensing plant will now provide steam for a station of much greater capacity than formerly. The methods of firing steam boilers have simultaneously undergone radical changes, so that in addition to the lower investment cost, due to the decreased total capacity of steam raising plant required, there is the further investment gain due to the more intense utilization of the plant. In view of these considerations, there will be no difficulty in realizing that a given outlay for buildings and machinery will be adequate for delivering much more electricity per annum than formerly.

At the same time it must be recognized that in and near large cities there has been a counteracting tendency to require much finer buildings with much greater attention to architectural effect, and since, as Mr. Lieb has pointed out, the cost of land and buildings may easily be the largest item for such undertakings, any lower investment cost per kilowatt for machinery permits of a much less percentage decrease in the total cost than is obtained in the case of such plants as those to which my paper had specific reference. My paper dealt exclusively with plants of enormous capacity (in this case 100,000 kw.) located under such conditions that the outlay for machinery constitutes much the largest item. Under such circumstances the contrast between a modern plant equipped with machinery purchased at modern prices and the best plant which could be put down ten years ago and which would be of much smaller total capacity, owing to the then relatively small demand for electricity, is marked.

It should, in conclusion, again be emphasized strongly that my estimates do not apply to plants located in or near large cities. On the first page of my paper I called attention to "the great field for electricity for large manufacturing enterprises which can be located near the source of electricity supply." I expressly stated that my costs applied to the manufacture of electricity "in bulk" and "under favorable conditions" and I was very precise in pointing out that my costs did not apply to electricity manufactured in and near large cities.

Well Merited Promotion

Mr. C. H. Mitchell, C.E., has been promoted to the rank of Lieut-Colonel and appointed general staff officer on the Headquarters Staff of the first Canadian Contingent. Col. Mitchell is equally well known in military and engineering circles, in both of which he has established a continental reputation.

Lieut.-Col. C. H. Mitchell.

Cost of Reproducing Utility Properties

A Detailed Analysis of the Various Elements that Enter into the Reproduction of any Public Utility—Not Forgetting the Cost of Building Up the "Business"

The cost of reproducing the property of a utility is made up of:

1. The cost of reproducing the plant.

2. The cost of reproducing the business which was attached at the time of the investigation.

The reproductive cost new of such property (both plant and business) means the cost of reproducing the property as constituted at the time of the investigation. The cost of reproducing the property as of a given date should take into account all physical, municipal, industrial, and other conditions existing at that time, which affect the cost of labor, materials, engineering, administration, financing and securing of business, together with all other items which enter into the reproductive cost new of the plant and business as an entirety. Where two or more utilities are operated by a single company, each utility must be valued separately, and the value of any property which is used in common by some or all of the utilities must be apportioned among them in the proportion in which such common property is used by each utility.

The types of units actually in use should be taken, and no theoretical substitution should be made of units of a different type which might be capable of rendering equal service.

The material prices and labor costs to be used should be those on which it would be fair and reasonable to figure in reproducing the property of the utility, making due allowance for market fluctuations and any abnormal conditions. In the case of abnormal conditions affecting market prices, fair prices may be determined by means of a trend curve going back far enough so that the trend price would not be materially affected by going back further. The period for which the trend curve is plotted has no relation to the length of time that would be required to reproduce the property.

In view of the fact that the reproduction of a plant and its business as it exists upon the date of the inventory and appraisal will extend over a considerable period of time, and that construction work will continue to the end of the period, it is obvious that the owner must bear the cost of interest on money expended for reproduction of both plant and business from the time it is raised until such reproduction is complete, and also the cost of insurance and taxes over the same period. In order to arrive at the proper amount of interest, insurance and taxes to be added to the other reproductive costs, it is necessary to estimate the reasonable period which such reproduction of the plant and business will require. This period will be different for different utilities and properties of different size. Due to lack of appreciation of the many elements to be considered in making this estimate there is a general tendency to assume a much shorter period than is in fact required. The period should begin when the proposition is first conceived and follow through all the successive steps to completion along such lines as obtain today.

OUTLINE OF INVENTORY

It is necessary that the inventory should show the following:

I. Reproduction cost new of:

A. Preliminary work.—(1) Preliminary investigation. (2) Organization of company. (3) Cost of financing. (4) Franchise.

B. Physical plant, consisting of,—(1) Land. (2) Rights-of way and water rights. (3) Buildings. (4) Generating or pumping plant, exchange equipment, etc. (5) Distribution and transmission systems, track, etc. (6) Tools, teams, vehicles, etc. (7) Furniture and fixtures. (8) Working capital: (a) Cash and other quick assets; (b) Stores and supplies. (9) Other items of physical property.

C. Established business.—(1) Cost of organizing and training operating, selling and clerical forces. (2) Cost of selling service. (3) Any other costs of attaching business.

II. Any other elements of going value or goodwill.

III. All other elements of value.

PRELIMINARY COSTS

There are necessarily certain costs and expenses which precede the work of actual construction of the plant or development of the business of a utility. Such costs cannot be avoided and must be borne ultimately by the company which becomes the owner of the property. In order to appreciate duly the number and extent of these costs, the person appraising the property should begin with the very inception of the idea, and as far as possible estimate all the necessary costs up to the time of the actual work of construction of the plant. Some of these necessary preliminary costs are the following:

1. Preliminary Investigation.—This should include all costs from the conception of the idea to the time of organization of the company, such as investigations as to the feasibility of the project, and similar preliminary expenses; not including, however, promoters' compensation, which is classified under "Organization."

2. Organization.—This should include all fees paid to the state for the privilegt of incorporation and all fees and other expenditures incident to organizing the utility. It should include the cost of preparing and distributing prospectuses, cash fees paid to promoters, and the actual cash value at the time of organization of securities paid to promoters for their services in organizing the enterprise, cost of preparing and issuing certificates of stock, bonds or other securities. It should also include legal services required in connection with the drafting of articles of incorporation, by-laws, corporate records of proceedings of directors and stockholders necessary to complete the corporate organization of the company, certificates to the secretary of state, preparing of stock certificates, bond mortgage, and all other documents connected with the issuance of securities, preparing application and securing consent to the issuance of securities, expenses incident to an increase of the capital stock, and expenses of preparing and filing certificates of amendment to the articles of incorporation. This should not include any discounts upon bonds issued, nor any costs incident to negotiating loans or selling bonds or other evidences of indebtedness.

3. Cost of Financing.—This should include brokers' fees, bankers' commissions, underwriting expenses, cost of soliciting subscriptions for stock, and all other costs in connection with raising funds.

4. Franchise.—This should include only the amount actually paid to any municipality or other political subdivision of state or county for the grant of the franchise.

LAND

That part of the inventory and appraisal which treats of the land owned by the utility should set forth the following data:

I. Original Cost

(1) The original cost, including purchase price, or award and expenses of condemnation proceedings; broker's fee;

the cost of surveying and expenses in connection with choice of the site; attorney's fees, and expenses due to any law-suit in connection with the establishment of lines; abstract company's fees; recorder's fees and expense of registering title; taxes and assessments accrued to date of transfer of title, and all other liens upon the title, when assumed by the purchaser; payments for damages to abutting property and cost of grading land when not done in connection with buildings.

(2) Date and conditions of acquisition, whether by direct purchase, exercise of power of eminent domain, or otherwise.

II. Value at Some Stated Date

In determining the value of the land to the utility, the Committee is of the opinion that it is proper to consider all expenses necessary in acquiring the land, including purchase price or award and expenses of condemnation proceedings; broker's fee; the cost of surveying and expenses in connection with choice of site; attorney's fees, and expenses due to any law suit in connection with the establishment of lines; abstract company's fees; recorder's fees and expenses of registering title; taxes and assessments accrued to date of transfer of title, and all other liens upon the title, when assumed by the purchaser; payments for damages to abutting property; and cost of grading land when not done in connection with buildings.

III. Additional Value by Reason of Present Use

If any parcel of land used by the utility is by its location or character especially well fitted to such use, the utility in fixing the value of said parcel should set up under this heading the additional value arising from such special or peculiar adaptability. Thus, for example, in considering the adaptability of a parcel of land for use as a site for a central station, due regard should be given to the following special features which might affect its value:

1. Location with reference to center of distribution.
2. Location with reference to transportation facilities.
3. Suitability of property for future growth.
4. Any other natural advantage, such as availability of supply of condensing water, etc.

RIGHTS-OF-WAY

This should include the cost of reproducing all rights-of-way acquired for the location of poles, wires, cables, conduits, pipe and track, whether such rights-of-way consist of land owned in fee or of easements acquired by permanent grants or through revocable licenses, oral or written; including the purchase price or award and expenses of condemnation proceedings, the cost of obtaining consents, the salaries and expenses of right-of-way agents and others employed in securing such grants, recorder's fees and all other expenses incurred in the acquisition of such rights. A discussion of these expenses is more fully set forth under Land.

WATER RIGHTS

This should include the cost of reproducing all water rights, whether acquired through purchases of the fee or through permanent grants or revocable licenses, oral or written; including the purchase price, or award and expenses of condemnation proceedings, the salaries and expenses of persons engaged in securing such grants, recorder's fees and all other expenses incurred in the acquisition of such rights. A discussion of these expenses is more fully set forth under Land.

BUILDINGS

The cost of reproduction of each building owned by the utility should include:

1. Such preliminary costs as the owner must incur for engineering and architectural expenses pertaining directly to the building in question.

2. The contractor's charge for reproducing the building. This should be based on one or more competent contractors' estimates, taking into account the entire building and all permanent fixtures, such as water, steam and gas piping and fixtures; electric wiring and fixtures for lighting, signalling, etc.; elevators; furnaces, boilers, and other apparatus for heating; and permanent foundations for machinery and apparatus.

The contractor's estimate should show quantities and unit prices and should take into account proper and sufficient allowances for delays due to strikes or other causes, contractor's profit, and his costs for money to meet all payments during the course of construction and until all payments have been made by the owner in accordance with the usual plan of payments.

In making his estimate the contractor should not omit those elements of cost which while not apparent in the finished building are necessarily incurred in connection with its construction. The following list will be suggestive of the type of items referred to: demolition of old buildings; general excavations; pits and trenches; pumping and drains; sheet piling and bracing; protection of street and repairs; protection and underpinning of adjoining buildings; cost of estimate; travelling, if any; fire insurance; liability insurance; bond; fees for building permits; water and permits; protection of work; stair guards and lights; rubbish; foundation piles; tests of steel, cement and other material; protection of masonry; cutting and patching; waterproofing; survey and levels; superintendence; temporary office; telephone; photographs; sheds; roadway and planking; temporary toilets; temporary heat; fence; temporary enclosures; watchmen; omissions and contingencies.

3. Architects' and owners' supervision, extras, changes and unforeseen expenses which are paid by the owner and which are not included in the contractor's estimate. In this should be included the cost of grading and sidewalks, fences, hedges, etc., on grounds used in connection with the building, and all other items not specifically included in the contractor's estimate.

WORKING CAPITAL

Working capital may be defined as the amount of supplies, cash, and other quick assets necessary for the safe, prudent and efficient transaction of a utility's business. It is impossible to lay down any definite rule for estimating the proper amount to be allowed for this item, and this must be determined by each utility with regard to its ordinary outstandings, both payable and receivable, its methods of collections, the natural risk of the business, and the condition of its credit. The allowance should be sufficient to care for emergencies and contingencies as well as the ordinary expenses of operation.

UNIT COSTS

It is a well-known fact that the plant of a public utility is never constructed as an entirety, or within the theoretical period of construction assumed by the reproductive method of valuation. On the contrary, a considerable portion of every plant is constructed through the gradual addition of extensions and improvements to that portion of the plant which was originally constructed. This experience is ordinarily called Piece-Meal Construction. Examples of such construction are as follows:

In the case of a telephone plant, extensions of lines and installation of drops, etc.; in the case of an electric light plant, similar extensions of lines for the installation of loops and transformers; in the case of an electric railway, track extensions, connections and switches, built from time to time; and in the case of water and gas plants, the extension of mains and the installation of services.

The cost of construction of a plant by the usual method is of necessity greater than the cost of construction of a plant built as an entirety within the theoretical period of construction. It is therefore obvious that in the valuation of a plant, due regard must be given this usual method of construction in the determination of unit costs; and these costs will vary somewhat in accordance with surrounding circum-

stances and conditions. Where practicable, unit costs should be secured from actual day to day performance of the work, and where such data is not available, estimated unit costs should be representative of day to day performance of the work.

The following are the elements which enter into the cost of any unit:

1. Cost of unit f.o.b. point of supply.
2. Cost of purchasing.
3. Cost of inspection.
4. Freight, switching, expressage or cartage to point of delivery, or to utility's store-room or yard.
5. Cost of unloading.
6. Cost of any work at point of delivery, or in shop, store-room or yard, in preparing unit for use.
7. Cost of hauling to point of use, whenever different from point of delivery.
8. Shop, store-room or yard charges.
9. Labor, including expenses of transportation, board and incidentals, and foreman's time and expenses, in performance of all work at point of use, including lost time and delays in work.
10. Tools and appliances.
11. Incidental Material.
12. Breakage, Loss and Waste.
13. Construction superintendence.
14. Employers' liability insurance.
15. Public liability insurance.

The foregoing schedule contemplates that the work will be done by the utility's own organization. Where any work is in practice done by a contractor, all items of expense included in the contractor's price should be substituted in place of similar items covered in the above schedule of unit costs.

OVERHEAD COSTS

There are certain general costs, in addition to the direct or unit costs, which every company must incur in the reproduction of its property, including its plant and business, and for which it must make actual money expenditures. These are commonly termed "Overhead Costs," and are of such a character that they cannot be conveniently apportioned to the units of the property. The costs which should be allocated to the units have been outlined under "Unit Costs," and the overhead expenses, which should be treated as a gross sum or apportioned to large groups of units, are described below. However, no hard and fast line of distinction can be drawn, and each utility must use care in the manner in which these items are treated to avoid duplicating in the gross overheads any items which have been allocated to the units. Apportionments among the groups of units may be advisable where one or more of the overheads apply in varying percentages to the various groups of units; but in such case care must be taken that the apportionments are made correctly.

Experience in making appraisals indicates that the following costs should be treated as overheads:

(1) Legal. (2) Administration and supervision. (3) Engineering. (4) Insurance during reproduction. (5) Taxes during reproduction. (6) Interest during reproduction. (7) Contingencies. (8) Omissions and oversights.

1. Legal.—This should include the cost of all fees and expenses paid to lawyers, attorneys, or counsel for services or advice required of them during the reproduction period of the property, that have not been included specifically in any other item. Such services would be the following:

Preparation of franchises, contracts, rights-of-way agreements, and all other documents of whatever nature required by the company in the acquisition of its property and rights.

The adjustment of claims for damages and injuries to persons and property.

Attention to injunction and other cases.

General advice from day to day.

Services in connection with corporate meetings.

Services in negotiations for franchises.

All other legal services.

2. Administration and Supervision.—This should include the salaries and expenses of all executive and other officers which are general to the property, and related general expense, such as the salaries and expenses of assistants and clerks, general office rent, and similar expenses necessary in the reproduction of the property, including both plant and business, not already included under Unit Costs or Cost of Reproducing the Business.

3. Engineering.—This should include expenditures for engineering, either the fees paid designing and consulting engineers, or the salaries, housing and expense of the engineering force required in preparation of specifications and preliminary and working plans for all construction work; making of cost estimates and reports, and the investigation and determination of proper construction practices; checking of contractors' plans, specifications and bids; checking of work for payments on estimates; testing or inspection for acceptance; and advising on work in progress until completed.

The above does not include the construction engineering work done and allocated to the Unit Costs under Construction Superintendence, Item 13 of Unit Costs; or the engineering during preliminary investigations; or commercial engineering, which is included under the Cost of Reproducing the Business.

4. Insurance During Reproduction.—This should include all costs of fire, casualty and any other insurance during the period required to reproduce the property, including plant and business, except such as are included in the Unit Costs.

5. Taxes During Reproduction.—As a part of the reproductive cost of its property a utility should include the cost of all taxes and assessments on property during the reproduction period, except assessments for street, sewer and other improvements which are included as a part of the cost of the land.

6. Interest During Reproduction.—As it is inevitable that the capital invested in the reproduction of the property, including plant and business, must remain unproductive until the plant passes into service, interest on this capital is one of the necessary costs of reproduction. Interest should be computed on the amounts entering into the cost of the property from the time these funds are required until the plant is placed in service.

7. Contingencies.—In spite of due supervision, careful planning and competent management, all difficulties and problems actually encountered in the performance of work can not be entirely foretold and their cost accurately estimated in advance. The character of these contingencies is so varied that it is not possible to anticipate in what form they will arise. Among others there are storms, floods, protracted bad weather, fires, explosions, strikes, riots and civil disturbances. In general practice it is customary to add to all estimates some per cent. allowance under each class of property to cover these contingencies. This should be done in an estimate of the cost of reproduction of the property.

8. Omissions and Oversights.—It is the experience of all appraisers that although reasonable care and thoroughness are exercised, it is not practicable to make an inventory and appraisal of a property without unconsciously omitting things which actually represent expenditures. Therefore a reasonable allowance should be included under this heading to compensate for items of property omitted from the inventory. Generally such allowance is covered by a percentage to be added to each class of property.

APPORTIONMENTS

Where two or more utilities are operated by a single company, and portions of the plant, transmission lines, distributing systems, or other equipment or property are used in common by some or all of these jointly operated utilities, the value of such jointly used property should be apportioned

among the various utilities in proportion to the service requirements made by each utility upon such property.

Where a single company operates two or more utilities, and maintains a stock of supplies for the benefit of some or all of these utilities, the value of this stock of supplies should be apportioned among the utilities in proportion to the service requirements made upon the total supply by each of the various utilities.

COST OF REPRODUCING THE BUSINESS

The reproduction cost of a property embraces not only the physical property, but also all attributes of the property, including its developed earning power. The cost of reproducing the business should therefore be treated as an element in the value of the property. It cannot be separated from the physical property; for example, if the plant is sold, the sale of the property carries with it the patronage and the power to earn. The cost of reproducing the business should not go into the unit costs because it is not a part of the units which these costs cover. Moreover, there is no depreciation of this item to be taken into account. Hence the cost of reproducing the business should include all the necessary costs of attaching the business and reproducing the income of the utility as at a given date. Some of the elements of expense which enter into the cost of reproducing the business are as follows:

1. The cost of organizing and training the operating force, and all employes whose work requires skill peculiar to the business of the utility, such as exchange operators, motormen, conductors, dispatchers, roadmen, signal operators, meter readers, installers, linemen, troublemen, and repairmen.
2. The cost of organizing the clerical force.
3. The cost of organizing and training the selling force.
4. The cost of securing customers, including expenses of solicitors, advertising, printing, free wiring or other inducements.
5. The cost of commercial engineering.
6. The cost of printing all forms, records, books, schedules and directories.
7. The rent of commercial offices (where not owned).
8. Any other cost, not included above, necessary to the development of the business found to exist on the date of the inventory.

DEPRECIATION

The term "depreciation" has been variously defined by different writers, depending upon the point from which they view the question, but it is believed that depreciation may properly be defined as the reduction in value caused by physical deterioration and any present obsolescence or lack of utility, if such exists.

Several methods have been used by appraisers in determining depreciation. These methods are:

1. Theoretical Methods.
   - (a) The Straight Line Method.
   - (b) The Sinking Fund Method.
2. The Actual Inspection Method.

Straight Line Method.—The Straight Line Method of estimating depreciation is based upon the assumption that the wearing value of a piece of apparatus decreases uniformly from year to year. Hence the method employed is to determine as nearly as may be the life of the unit, divide 100 by the life in years to arrive at the annual percentage of depreciation, and multiply this annual percentage by the number of years the unit has been actually in use. The product is taken as the percentage of accrued depreciation of the unit.

Sinking Fund Method.—The Sinking Fund Method assumes that an amount is set aside each year, which, invested at compound interest, will equal the total wearing value at the end of the assumed life. This differs from the Straight Line Method only in that the amount assumed to be set aside annually as an addition to the hypothetical reserve fund is smaller, due to the compounding of the interest. The depreciation at any time is said by the advocates of this method to exactly equal the amount that is or should be in the sinking fund accumulated in this way.

Both of these methods make use of life tables showing average length of life of similar units. Often these tables do not represent exhaustive studies of any great number of units. Furthermore, unless the life tables are compiled with reference to conditions similar to those surrounding the operation of the unit in question, they are practically worthless as a basis for estimating the length of life of a unit. Frequently such tables are averages taken from records of units operating under widely diverse conditions; hence give no index to the depreciation of a unit working under definite circumstances. Moreover, these tables are based upon studies of units installed many years ago, and operated under conditions prevailing during that period, which are necessarily different from conditions under which similar units are operated today, or will be operated in the future. Moreover, such life tables are open to objection, because they necessarily fail to accurately measure:

1. The wear and tear which has actually taken place on the unit in question.
2. The standard of maintenance employed.
3. The element of inadequacy.
4. The element of obsolescence.

The Actual Inspection Method.—The objections which have been urged against estimating depreciation by any of the theoretical methods are met by the use of the actual inspection method. Here the depreciation is determined through actual inspection by an appraiser, and the application of his judgment, verified by such tests as may be practicable. By the inspection method, due allowance is made for the actual wear and tear and the standard of maintenance employed. It is the consensus of opinion that this method affords the fairest measure of depreciation that can be applied to a property.

In the use of this method, it is essential that the appraiser must actually inspect not only the unit as a whole, but the component parts of the unit. From his knowledge and experience he must determine the physical condition of the property or unit with reference to the same property or unit new. In making this determination, the age or length of time that such unit has been in service is immaterial.

For example, two similar units may have been installed in different plants at the same time; the first maintained in the best possible condition, or subjected to light service; the second, neglected or carelessly maintained, or heavily overloaded. As a result, the second unit would be found in much lower physical condition than the first. The respective conditions of these units could be arrived at only by inspection.

A further illustration of the advantage and importance of the inspection method in accurately estimating depreciation, is found in the case of water and gas pipes, and underground conduits and cables. Upon examination, it may be found that in one community or district, irrespective of age, the physical condition of the property may be approximately 100 per cent., while in another community or district, due to peculiar local conditions, there may be found a considerable wasting away of materials. The advantage of the inspection method over any theoretical method for accurately appraising the present condition of property is in this case manifest.

The following suggestions are offered as an aid in arriving at the exact amount or percentage to be allowed for depreciation by the use of the inspection method:

Where a unit has deteriorated, but is capable of being restored to approximately 100 per cent. condition, through repairs or the replacement of parts, the amount of depreciation will be measured by the cost of the repairs necessary to

restore the unit, plus an allowance for any other existing depreciation which cannot be made good by repairs.

For example, a pole which shows rot at the ground line may be reinforced at that point with concrete, and the weakness thereby eliminated. The cost of making these repairs, together with an allowance for any depreciation found to exist in the upper part of the pole, would be the measure of the depreciation.

The cost of restoration is a measure which will be readily applied by the average operator, who is familiar with the expense of repairing units. Or the costs of such repairs may be easily ascertained from the records of the company, or from estimates of competent parties.

In some instances it may be found impracticable to apply this measure, due to the fact that some units do not lend themselves readily to repair. In such cases, the appraiser must, in the exercise of sound judgment, determine the amount of wear and tear that has accrued, and with reference to the remaining service or wearing value, assign a just amount of depreciation to the unit in question.

The value of almost every unit or piece of property may be divided into two parts: (a) wearing value, and (b) scrap, salvage or other remaining value, such as re-use value.

The scrap or salvage value of a unit is its value or its fair market price as old material, after deducting the cost of removal. The difference between the cost of the unit and its salvage value is the wearing value. Since the salvage value as of a date certain is fixed, and therefore not subject to depreciation, the only part of the value of the unit which may be depreciated is the wearing value.

In the case of certain units the scrap or salvage value might be zero, i.e., the cost of removal might equal or even exceed the fair market price of the old material. In such an instance the wearing value and the reproductive cost new would be equal, and the entire reproductive cost would therefore be subject to depreciation.

An example of a unit which has salvage value is insulated copper wire. The value of the copper itself is the salvage; and the wearing value, which alone is subject to depreciation, is the difference between the salvage value and the cost new of the wire in place.

Where a unit has a value to the utility for re-use at some point in its plant, this re-use value should be taken in preference to the salvage value as the point below which depreciation of the unit does not go. To illustrate: A railroad company may use an 80 lb. rail in its main line until it is so worn that it is no longer useful in that place. But while not safe for use in the main line its value for use in a branch line or on a siding may be equal to 75 per cent. of its reproduction cost.

Another illustration is found in the case of a pole of, say 60 feet, which has been in service and has become decayed at the ground line and therefore unsafe. The pole may be removed, shortened, and reset as a 50 foot pole. As reset, it may have a value of from 40 to 60 per cent. of its reproduction cost new.

DEPRECIATION RESERVE

Any reserves which any utility may have set up in the past or may set up in the future must not be confused with the actual depreciation of the property.

Depreciation and Depreciation Reserve are two distinct and independent things.

Depreciation has been defined in the foregoing pages

Depreciation Reserve is a fund set aside in anticipation of the occurrence of depreciation or loss or destruction of any part of the serviceable plant from any cause whatsoever. It is in the nature of an insurance fund to guarantee the condition of the life of the property and keep it in a condition to render satisfactory service. It is from this depreciation reserve fund that provision must be made to cover replacements made necessary not only by mechanical deterioration, but also by storms, floods, municipal requirements, obsolescence, changes in the art and all other kinds of contingencies which in the nature of things cannot be foreseen.

It is important to note that neither the amount in the depreciation fund nor the amount which ought to be in such fund is in any way a measure of the depreciation or loss of value which has already taken place, nor does it afford a measure of the rate at which depreciation or loss of serviceability will occur in the future.

DEPRECIATION OF PRELIMINARY AND OVERHEAD COSTS

The real test as to whether there is or can be any depreciation of such values will depend upon whether in the replacement of any unit the overhead costs must be reincurred. Subjecting the overhead and preliminary costs to this test, it is found that the costs of preliminary investigation, organization, financing, franchise, legal, administration, general engineering, interest, insurance and taxes during reproduction do not, upon the replacement of any unit, need to be reincurred to any appreciable extent. Therefore, the depreciation in these values, if any exists at a given time, is so small that it is impracticable to compute it, and the utilities are justified in ignoring it in making up their inventories.

The depreciation of contingencies and omissions may be estimated to be the same as the average for the entire physical property.

Standardized Definitions

We give below additional standardized definitions as outlined in our issues of September 15 and October 15th. The following list includes many of everyday interest to the operating engineer,—

EFFICIENCY AND LOSSES

Machine Efficiency is the ratio of the power delivered by the machinery to the power received by it.

Plant Efficiency is the ratio of the energy delivered from the plant to the energy received by it in the same period of time,* the period of time to be suitably chosen.

REGULATION

Regulation. The regulation of a machine in regard to some characteristic quantity (such as terminal voltage or speed) is the change in that quantity occurring between any two loads. Unless otherwise specified, the two loads considered shall be zero load and rated load and at the temperature attained under normal operation. The regulation may be expressed by stating the numerical values of the quantity at the two loads, or it may be expressed by the "percentage regulation" which is the percentage ratio of the change in the quantity occurring between the two loads to the value of the quantity at either one or the other load, taken as the normal value. It is assumed that all parts of the machine affecting the regulation maintain constant temperature between the two loads, and where the influence of temperature is of consequence, a reference temperature of 75 deg. C. shall be considered as standard. If change of temperature should occur during the tests the results shall be corrected to the reference temperature of 75 deg. C.

The normal value may be either the no-load value, as the no-load speed of induction motors; or it may be the rated-load value as in the voltage of a.c. generators.

It is usual to state the regulation of d.c. generators by giving the numerical values of the voltage at no load and rated-load, and in some cases it is advisable to state regulation at intermediate loads.

The Regulation of d.c. Generators refers to changes in

* An exception should be noted in the case of the efficiency of storage batteries.

voltage corresponding to gradual changes in load and does not relate to the comparatively large momentary fluctuations in voltage that frequently accompany instantaneous changes in load.

In determining the regulation of a compound-wound d.c. generator, two tests shall be made, one bringing the voltage down and the other bringing the voltage up between no-load and rated load. These may differ somewhat, owing to residual magnetism. The mean of the two results shall be used.

In constant-potential a.c. generators, the regulation is the rise in voltage (when the specified load at specified power factor is thrown off) expressed in per cent. of normal rated-load voltage.

In constant-current machines, the regulation is the ratio of the maximum difference of current from the rated-load value (occurring in the range from rated-load to short-circuit, or minimum limit of operation), to the rated-load current.

In constant-speed direct-current motors, and induction motors, the regulation is the ratio of the difference between full-load and no-load speeds to the no-load speed.

In constant-potential transformers the regulation is the difference between the no-load and rated-load values of the secondary terminal voltage at the specified power factor (with constant primary impressed terminal voltage) expressed in per cent. of the rated-load secondary voltage, the primary voltage being adjusted to such a value that the apparatus delivers rated output at rated secondary voltage.

In converters, dynamotors, motor-generators and frequency converters, the regulation is the change in the terminal voltage of the output side between the two specified loads. This may be expressed by giving the numerical values or as the percentage ratio.

In transmission lines, feeders, etc., the regulation is the change in the voltage at the receiving end between rated non-inductive load and no load, with constant impressed voltage upon the sending end. The percentage regulation is the percentage change in voltage to the normal rated voltage at the receiving end.

In steam engines, steam turbines and internal combustion engines, the percentage speed regulation is usually expressed as the percentage ratio of the maximum variation of speed to the rated-load speed in passing slowly from rated load to no load (with constant conditions at the supply). If the test is made by passing suddenly from rated load to no load, the immediate percentage speed regulation so derived shall be termed the **fluctuation.**

In a hydraulic turbine, or other water motor, the percentage speed regulation is expressed as the percentage ratio of the maximum variation in speed in passing slowly from rated load to no load (at constant head of water), to the rated-load speed.

In a generator unit consisting of a generator combined with a prime mover, the speed or voltage regulation should be determined at constant conditions of the prime mover, i.e., constant steam-pressure, head, etc. It includes the inherent speed variations of the prime mover. For this reason, the regulation of a generator unit is to be distinguished from the regulation of either the prime mover, or of the generator combined with it, when taken separately.

Luminous Flux is radiant power evaluated according to its capacity to produce the sensation of light.

The Luminous Intensity of a point source of light is the solid angular density of the luminous flux emitted by the source in the direction considered; or it is the flux per unit solid angle from that source.

Candle. The unit of luminous intensity, maintained by the National Laboratories of France, Great Britain, and the United States. This unit, which is used also by many other countries, is frequently referred to as the international candle. The Hefner unit is 0.90 of the international candle.

Candle-Power. Luminous intensity expressed in candles.

Lumen. The unit of luminous flux, equal to the flux emitted in a unit solid angle (steradian) by a point source of one candle-power.

Illumination on a surface, is the luminous flux-density over that surface, or the flux per unit of intercepting area.

Lux. A unit of illumination equal to one lumen per square meter. The C. G. S. unit of illumination is one lumen per square centimeter. For this unit Blondel has proposed the name "Phot." One milli-lumen per square centimeter (milliphot) is a practical derivative of the C. G. S. system. One foot-candle is one lumen per square foot and is equal to 1.0764 milliphots. The foot-candle is the commonly employed unit of illumination in English speaking countries.

Coefficient of Reflection. The ratio of the total luminous flux reflected by a surface to the total luminous flux incident upon it. It is a simple numeric. The reflection from a surface may be regular, diffuse or mixed. In perfect regular reflection, all of the flux is reflected from the surface at an angle of reflection equal to the angle of incidence. In perfect diffuse reflection, the flux is reflected from the surface in all directions in accordance with Lambert's cosine law. In most practical cases, there is a superposition of regular and diffuse reflection.

Performance Curve. A curve representing the behavior of a lamp in any particular (candle-power, consumption, etc.) at different periods during its life.

Characteristic Curve. A curve expressing a relation between two variable properties of a luminous source, as candle power and volts, candle-power and rate of fuel consumption, etc.

Mean Horizontal Candle-Power of a lamp,—the average candle-power in the horizontal plane passing through the luminous center of the lamp. It is here assumed that the lamp (or other light source) is mounted in the usual manner, or, as in the case of an incandescent lamp with its axis of symmetry vertical.

Mean Spherical Candle-Power of a lamp,—the average candle-power of a lamp in all directions in space. It is equal to the total luminous flux of the lamp divided by 4π.

Mean Hemispherical Candle-Power of a Lamp (upper or lower),—the average candle-power of a lamp in the hemisphere considered. It is equal to the total luminous flux emitted by the lamp in that hemisphere divided by 2π.

Mean Zonal Candle-Power of a lamp,—the average candle-power of a lamp over a given zone. It is equal to the total luminous flux emitted by the lamp in that zone divided by the solid angle of the zone.

Incandescent Lamps, Rating. It is customary to rate incandescent lamps on the basis of their mean horizontal candle-power; but in comparing incandescent lamps in which the relative distribution of luminous intensity differs, the comparison should be based on their total flux of light measured in lumens, or on their mean spherical candle-power.

Conduit Work in Montreal

The city of Montreal is fortunate in being able to continue the construction of its underground conduits. When the financial skies became clouded as the result of the European war, the Council found it necessary, owing to shortage of funds, to temporarily abandon the work, thus throwing many men out of employment. The contractor, M. G. M. Gest, made an offer to the Council to continue the construction work and defer settlement until June, 1915, which offer was accepted. By this means the work is being carried out at a favorable time and necessary employment is being given to several hundred men, many of whom would otherwise be idle. Such an arrangement is strongly to be commended, and we congratulate the city of Montreal, and likewise Mr. Gest for his enterprise.

Electric Railways

Selecting Railway Motor Equipments

By J. F. Layng*

The following article furnishes outlines of several calculations which have been selected for the purpose of emphasizing the importance of a complete appreciation of all the governing factors (especially the so-called minor ones) which must be considered when figuring on a railway motor equipment that is to fulfill given conditions. Each new railway problem entails the satisfying of a great number of complex factors and if it does not receive the most minute attention, the best results are not likely to be attained. The author of this article, therefore, points out briefly the effects of local conditions and the characteristics of apparatus which must not be overlooked in calculations.—Editor.

When selecting railway motor equipments it is necessary to have a definite picture of the service or of the work to be performed in order to choose a motor of the proper size and correct gearing, for successful performance. Sometimes the failure to appreciate what schedule speeds, maximum free running speeds, stops per mile and car weights mean, causes electrical equipments to be purchased which are either too large or too small. Consequently in some cases an equipment that is more expensive either in first cost or in maintenance than is required is purchased.

To make any schedule speed with a certain number of stops per mile, there is one definite free running speed that will perform the service most economically, not only in regard to power consumption, but also with reference to the size of equipment selected. The variations in the amount of power required for a car operating on free running speed can be illustrated by taking a 40-ton car as an example: When running at constant speed on level tangent track at twenty miles an hour, this car will require 23.1 kw. input. Providing this speed is increased to thirty miles an hour under the same conditions, this car will take 44.1 kw., and at forty miles an hour 76.2 kw., at fifty miles an hour 124 kw., and at sixty miles an hour 188 kw.

It can readily be seen from these figures that an increase in free running speed, which will bear a certain relation to an increase in schedule speeds, shows a very rapid increase in power consumption, and consequently a much larger equipment is required as the faster speeds are approached. Of course the longer the time that can be allowed to perform a certain schedule the smaller will be the equipment, and the cheaper will be the operation.

It is frequently found when investigating service conditions that the stops per mile made by any equipment vary widely from estimates based on superficial observation. The answers that will be given by different train crews as to the number of stops which they make on a particular trip will be surprising, unless they are especially requested to keep an actual record. Frequently answers to this question vary by more than 100 per cent. for the same run. The number of stops per mile in interurban work is a much more deciding factor than in city work. In city service, where eight to nine stops per mile are made, variation in the number does not so seriously affect the size of the equipment. The reason for this is obvious from the following: Suppose a car is operating on an eight mile per hour schedule, with ten stops per mile, within an hour it would make a total of eighty stops. With stops of 10 seconds this would mean that the car was standing still for 13.35 minutes, or 22.2 per cent. of the total time. Providing the same car is making nine miles per hour, and six stops per mile, the car would be standing still 9 minutes of the time, or 15 per cent. Strange as it may seem, if the stops per mile were sufficiently great, and the schedule speed were reduced, the size of the motor could be greatly decreased.

The information which it is necessary to have in selecting a car equipment is as follows:

1st, Car weight without live load, but including all equipment accessories, except the electrical equipment, which can be added by the engineer.

2nd, Seating capacity.

3rd, Schedule speed.

4th, Stops per mile.

5th, Length of stops.

6th, Grades.

7th, Voltage.

8th, Diameter of wheel.

9th, Layovers either ends of line, or at any point during the run.

Providing cars are to operate in a mixed city, suburban and interurban service, the data insofar as actual running time, number of stops, and length of stops are concerned should be divided into zones. Securing the information in this way makes it possible to have the proper calculations made for the equipment to be selected. The choosing of a proper motor equipment must be based on experience, and is not simply a mathematical calculation which can be determined by a fixed formula.

Frequently a motor will be selected that can be geared to give the schedule requirements, but the heating may be excessive, or vice versa, the motor being too large for the service, and it will be found that a smaller and consequently lower cost equipment could be chosen for the service.

Manufacturing companies in every case make careful calculations to determine positively that, insofar as the data as presented are concerned, the correct equipment is furnished. Assume that we are to select a motor for city service, on which the general data are as follows:

Car weight complete with all equipment	42,000 lb.
Live load	6,000 lb.
Schedule speed	10 m.p.hr.
Stops per mile	7
Length of stop	10 sec.
Average voltage	500
Diameter of wheels	33 in.

By taking the total weight of car, including the live load, it will be found we have 24 tons. Provided the grades are more than 5 per cent., ordinarily a four-motor equipment would be selected. If this is the case we should have a weight of 6 tons per motor.

*In General Electric Review

In starting an equipment there is a retardation due to the rotary elements, which is commonly figured at 7 per

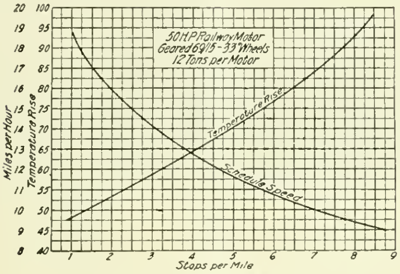


Fig. 1. Effect of Stops per mile on schedule speed and temperature for 50 h.p. motor

cent. additional to the car weight. In this particular case this addition would make a total of 6.42 tons per motor. Previous experience shows that this weight of car in the schedules specified, could be successfully handled by 40 h.p. 600 volt motors having a gearing of 67 to 14.

As a rule city cars accelerate at 1½ miles per hour per second. For the purpose of the trial calculation we will assume that accelerating 1½ miles per hour per second will give the desired schedule speed. In order to accelerate one ton at one mile per hour per second, 91.1 lb. per ton tractive effort are required. It can therefore be seen that if we desire to accelerate at 1½ miles per hour per second 137 pounds tractive effort will be required.

If we refer to the characteristic curve of this motor it will be seen that this will require, for the car weight which we have selected, 1026 lb. tractive effort, or 61 amperes input. This ampere input is approximately the hourly rating of the motor, and should, of course, produce satisfactory commutation. Generally speaking it is not good practice, insofar as calculations of schedules are concerned, to have a motor accelerate much in excess of its hourly rating, unless the motor has been specially designed to have a sufficient margin in commutation. With the tractive effort definitely determined from the characteristic curve, it is a simple calculation to find what will be the maximum speed attained with this particular input and the time required to attain this speed. From the average speed and time the distance is readily figured.

After the car has reached the speed corresponding to this first calculation the current gradually decreases, and the increments of speed, time and distance are simply a matter of continued calculation to a point where it is deemed best to throw off power, and coast or brake. The usual rate of braking for a city service is 1½ miles per hour per second. The first figures may show that the calculations with power on have been carried either too far or too short to give the required distance and schedule speed. Usually it is necessary to make several calculations in order to get the values for time and distance, to make the schedule desired. Curves and grades greatly influence the calculations, but to explain the different allowances to be made for them would complicate the discussion, and therefore the explanation has not been included.

Providing the information which we have previously mentioned is given correctly, and the service is actually performed as outlined, it is possible to calculate the actual temperature rise of the different parts of the motor within 2 or 3 degrees. This fact has frequently been proven by actual test in service.

From the figures which have been made to find the speed from the characteristic curve all the different losses in a motor can be definitely determined. These consist of copper losses, iron losses and friction. The sum of these three losses determines the heating for any particular motor.

With closed motors, in making calculations for temperatures, allowance should be made for differences in schedule. A motor when tested on a test stand at the factory will radiate a certain amount of heat. When operating on a car with a schedule speed of 10 m.p.hr. this same motor will run approximately 10 per cent. cooler. If the schedule speed is increased to twenty m.p.hr. it will run approximately 18 per cent. cooler than if it were tested upon the stand. With ventilated motors the temperature is directly affected by the armature speed, and much greater cooling is obtained. This greater cooling is not only realized in interurban service, but also in slow speed city service. Improvements in methods of ventilation will greatly increase this difference.

Fig. 1 shows the effect of stops per mile on schedule speed and of temperature in the case of a 50 h.p. motor. This particular curve is based on a car weighing 12 tons per motor, 550 volts (average), 33 in. wheels, 69/15 gearing and no coasting. With cotton insulation it is not advisable as a rule, to run motors much in excess of 65 degrees C. rise. By making slightly more than 4 stops per mile with a 12.6 m.p.hr. schedule it can be seen that the particular motor in question will have a temperature rise of 65 degrees. Providing the stops per mile are increased to 8, the schedule speed will necessarily fall to 9.4 m.p.hr. and the temperature rise will increase to 92½ deg. C. This excess in temperature rise indicates the necessity for correctly stating the service conditions. Providing the car weight had been reduced to a reasonable limit, the equipment would not only

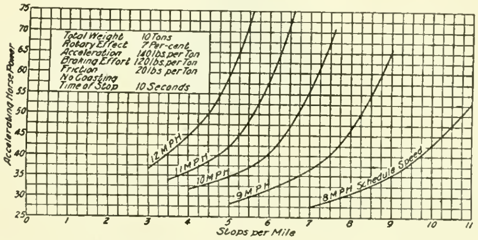


Fig. 2. Accelerating Horse power for 10-ton car

be capable of making faster schedule speeds, but would also have a reasonable temperature rise.

Fig. 2 shows the accelerating horse-power in different services for a car having a total weight of 10 tons, and illustrates the effect that stops per mile on this car will have on a required input. With 12 m.p.hr. schedule and 3 stops per mile, 36½ h.p. is required to accelerate this weight at approximately 1½ miles per hour per second. Providing the same schedule speed is maintained and the car makes 5½ stops per mile, 72½ h.p. will be required. With a 9 m.p.hr. schedule and 5 stops per mile, 28 h.p. will be required. If the stops are increased to 8 per mile with the same schedule, 46½ h.p. will be required. With an 8 m.p.hr. schedule and 7 stops per mile, 27½ h.p. will be required. If the stops are increased to 10 per mile, 43 h.p. will be required.

The second curve illustrates the effect of schedule stops per mile on a certain weight of car. The variation of the service requirements shown on this curve illustrates the variation in horsepower required to accelerate cars having a weight of 10 tons per motor, and shows how careful we should be in getting together the facts for the purchase of equipments.

The facts as brought out in this article are intended to illustrate the real necessity for securing accurate service data and the realization that the points which are necessarily covered, while apparently very simple factors in determining the most economical equipment that will give satisfaction in the work it is intended to do.

Illumination

Model Lighting Specifications

By Mr. Geo. J. Beattie

[Editorial note—In our issue of September 1st, we printed, in connection with an average size house of which the general ground plans were shown, a set of model plans and specifications for the wiring of this house for light and such

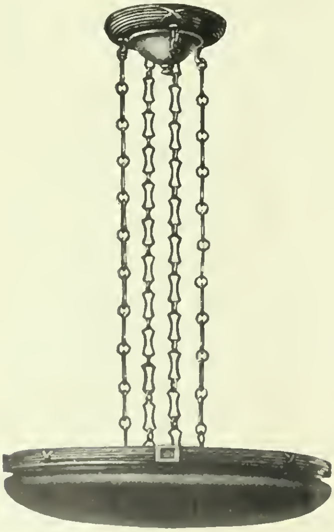
Type No. 1

power equipment as is nowadays considered necessary in the modernly equipped residence. This was followed on October 1st by a typical set of plans and specifications for the illumination of the same residence, the wattage being calculated having in mind the use, to a very considerable extent, of semi-indirect glassware. As the type of fixture that may be installed in such a home varies widely and, with it, the wattage necessary, we print below a further lay-out for the same residence. In the present case, the author evidently favors the indirect type of fixture.]

In recent issues of the Electrical News, there have been printed a typical set of plans and specifications for the wiring of a given residence of average size, and also a set of plans and specifications covering the illumination. In the present article, I wish to outline another typical selection of suitable fixtures and the necessary specifications. It will be noted that the use of indirect lighting is recommended for such spaces as the living room, dining room, reception hall, study and bed rooms. In the home, comfort is the prime requisite, and hence the illumination, in such rooms as the above in particular, should be selected with perfect comfort of vision as the chief consideration. Since experience, as well as the investigations conducted by prominent psychologists and illuminating engineers, have convincingly shown that the most comfortable artificial light is the indirect system, it should receive first consideration in the lighting of the home.

Specifications

These specifications are intended to cover the supply of all necessary material and labor for the installation of the



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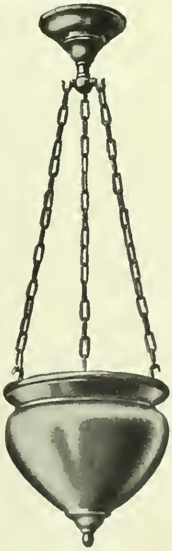


Type No. 3

Type No. 4

Type No. 5

Type No. 6

lighting fixtures complete in all details, in the new residence for ———— Toronto.

Working Conditions

The house will be ready for fixtures in approximately ——— days. The Contractor must be ready to install all fixtures as soon as the interior plastering, finishing, etc., is completed, and must cause no delay in the completion of his work.

Plans

Plan No. C-38 shows the location of the outlets at which fixtures must be installed. (This plan shown in issues of September 1 and October 1).

Schedule of Fixtures

The accompanying schedule of fixtures gives the number and type of fixtures, reflectors, lamps, etc., to be installed in the various rooms, and forms an integral part of these specifications.

Fixtures

All fixtures must be constructed of the material and finish specified, and in accordance with all rules and requirements of the National Board of Fire Underwriters.

Direct Lighting Units

All direct lighting fixtures must be constructed so that they may be supported from a ⅜-in. crowfoot. No other method of support will be permissible. The metal used shall not be less than No. 20 U. S. gauge. They shall be equipped with the type and size of shade holder specified. Where opal glass shades or reflectors are called for, a medium density opal glass is desired. The contractor will be required to furnish samples of the glassware he proposes to furnish to the architect for approval.

Indirect Lighting Units

The designs of the indirect bowls are suggestive. The contractor may furnish his own design of fixtures, but they should correspond to the specifications as regards general shape of bowl, size, and method of suspension, and must be submitted to the architect for approval.

Each fixture must be equipped with individual mirrored reflectors—X-Ray eye comfort, or equal—of the size and shape specified for each lamp, and the necessary interior equipment consisting of receptacles, holders, centre bodies, nipples and all requisite accessories, specified in the accompanying drawings and schedule.

Spun and stamped brass bowls shall be made of not less than No. 18 U. S. gauge metal.

Compo. bowls shall be made of a durable composition, which permits of being cast in artistic forms, and has a tough surface, which will take the finishes specified.

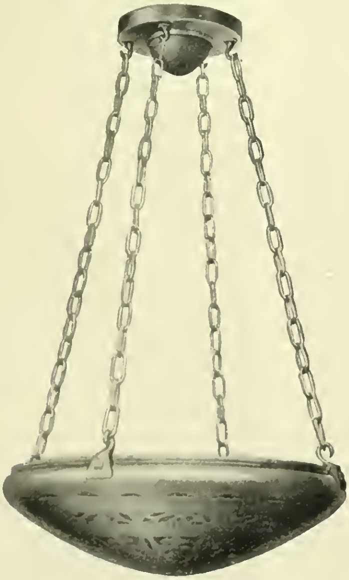
Glass bowls shall be a light density opal glass. Samples shall be submitted to the architect for approval.

Lamps

All lamps will be furnished by the proprietor.

Installation of Fixtures

The contractor will be required to install all fixtures at the outlets specified in the accompanying schedules and



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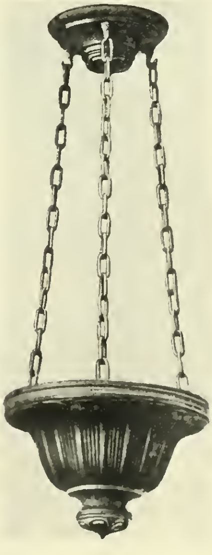

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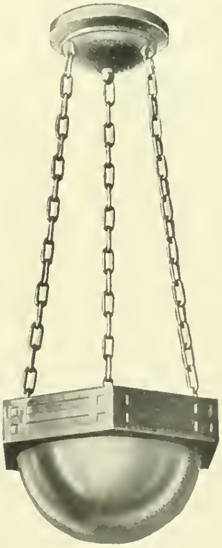

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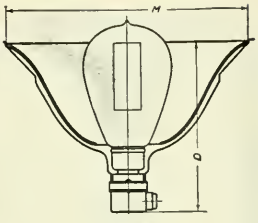

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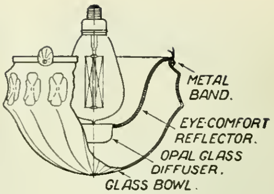

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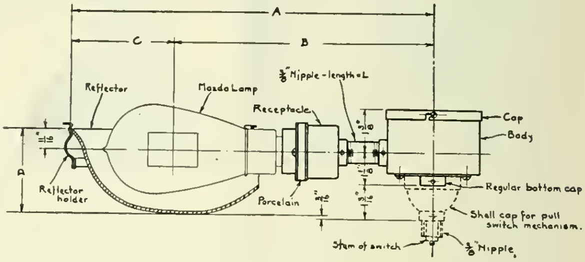

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plans, and will be responsible for testing out the circuits, and making proper connections.

The contractor must install all necessary lamps to complete the installation. Lamps will be delivered to the premises in good condition by the proprietor. The contractor will be held responsible for lamps during the installation.

The inspection engineer must be notified in writing as soon as contract is completed. Within thirty days after notification, the engineers will issue a final certificate of acceptance if on inspecting the work, it is found complete in all respects.

General Conditions

The same general conditions pertaining to the wiring specifications for this building shall be considered an integral part of these specifications.

The assistance rendered by the telephone in the operation of a large number of camps and drives by one central head is really remarkable. All parts of the work are constantly in touch with the manager and with each other. In place of a man walking or driving miles with the manager's instructions for a foreman, the manager or agent can call the foreman to the wire and then, after hearing the facts of the case from this man, can issue his orders direct.

A bill has been reported to Congress, recommending the government purchase and operation of the street railways in Washington.

SCHEDULE OF FIXTURES

Room	Ceiling height in feet	No. req'd	Fixture Type No.	Fixture Material	Finish	Lamps Per fixt.	Lamps Size watts	Reflector Direct Lighting Glass ware	Reflector Direct Lighting Shade-holder	Reflector Direct Lighting Suspension ‡	Indirect Lighting Type No.	Indirect Lighting Inter. equip't	Indirect Lighting Suspension ‡‡	Remarks
BASEMENT—														
Laundry	7 ft. 0 in.	2	1	Brass	Bauer Barff	1	40	Opal glass	2¼ 0	Ceiling band				
Hall	7 " 0 "	1	1	Brass	Bauer Barff	1	40	Opal glass	2¼ 0	"				
Storage	7 " 0 "	1	1	Brass	Bauer Barff	1	40	Opal glass	2¼ 0	"				
Furnace	7 " 0 "	1	1	"	"	1	40	Opal glass	2¼ 0	"				
GROUND FLOOR—														
Front Veranda	9 ft. 1 in.	1	12	Copper	Copper	1	40	R.I.	3¼ 0	"				Glass ball
Living Room	9 ft. 1 in.	1	2	Compo.	Roman gold	3	150				E155	7052	30 in.	
Entrance	9 " 1 "	1	12	Copper	Copper	1	40	R.I.	3¼ 0	"				Glass ball
Lower Hall	9 " 1 "	1	3	Brass	Antique brass	1	100				E100	8018	30 in.	
Upper Hall	8 " 7 "	1	3	"	"	1	100				E100	8018	30 in.	
Landing	8 " 7 "	1	3	"	"	1	60				E100	8018	30 in.	
Dining Room	9 " 1 "	1	4	"	Oxydized silver	4 1	60 10				E60	7012A	30 in.	Glass bowl
Rear Veranda	9 " 1 "	1	12	Copper	Copper	1	40	R.I.	3¼ 0	"				Glass ball
Coat Room	9 " 1 "	1	5	"	White enamel	1	25	Opal glass	2¼ 0	"				Pull socket
Kitchen	9 " 1 "	1	6	"	"	1	60	"	2¼ 0	"				
Pantry	9 " 1 "	1	5	"	"	1	25	"	2¼ 0	"				Pull socket
SECOND FLOOR—														
Study	8 ft. 7 in.	1	7	Brass	Antique brass	4	60				E60	7012	24 in.	
Bed Room No. 2	8 " 7 "	1	8	"	"	1	100				E100	8018B	24 in.	
Closets	8 " 7 "	7	5	"	White enamel	1	25	Opal glass	2¼ 0	"				Pull socket
Bed Room No. 1	8 " 7 "	1	8	"	Antique brass	1	100				E100	8018B	24 in.	
Bed Room No. 3	8 " 7 "	1	8	"	"	1	100				E100	8018B	24 in.	
Sun Room	8 " 7 "	1	9	"	"	1	100				E100	8018	24 in.	
Bath Room	8 " 7 "	1	6	"	White enamel	1	40	Opal glass	2¼ 0	"				
Toilet	8 ft. 7 in.	1	6	Brass	White enamel	1	25	Opal glass	2¼ 0	"				
ATTIC—														
Bath Room	8 ft. 0 in.	1	6	Brass	Brushed brass	1	40	"	2¼ 0	"				
Bed Room No. 4	8 " 0 "	1	10	"	"	1	100				E100	8018	18 in.	
Bed Room No. 5	8 " 0 "	1	6	"	White enamel	1	100				E100	8018	18 in.	
Hall	8 " 0 "	1	11	"	Brushed brass	1	25	Opal glass	2¼ 0	"				Pull socket

‡ Bottom of Reflector to Floor.
‡‡ Top of Bowl to Ceiling

The Dealer and Contractor

The Electric Christmas Gift

There is no More Satisfying or Educational Toy Than the Electric—Make it an Electrical Christmas for Men, Women and Children

Every boy longs for mechanical toys. At Christmas time he wants them worse than at any other time of the year—and gets them. Why not electric toys? There is probably not a single Canadian boy who would not shout "electric" if he had his choice. Are the dealers taking full advantage of this very natural and laudable inclination?

The objection to electric toys in the past has been in part their cost, in part the prejudice against them as a possible source of danger, and in part that they required skill to operate beyond that possessed by the ordinary boy. These objections do not hold today. Prices of electric toys compare very favorably with those of other kinds of Christmas joy makers; the danger element, if it really existed, has been entirely removed and the manufacture of even the cheaper forms has reached such a high degree of mechanical perfection that the skill required to operate and keep these toys in repair is reduced to a minimum.

And then, what about the advantages? Electric toys are pre-eminently clean and tidy. They are now so constructed that they outlast, many times, most other forms of mechanical toys. They are a keen source of pleasure (rather than amusement), even to the older members of a family, who enjoy them equally as much as the boys themselves, and—last and best—they furnish one of the most effective means of developing the boy's mind and giving him an insight into what is going on in the big world outside.

Unfortunately, perhaps, it is still the custom of the parents to buy the Chirstmas toys, and in their conservative wisdom such new-fangled things as electricity must give place, as yet, to rocking horses and express wagons. The next generation will undoubtedly view these matters differently, but in the meantime, a great deal more can be done towards displaying and demonstrating electric toys and other Christmas electric novelties and in pointing out their many advantages.

It is with the idea of assisting somewhat in this educational campaign that we reproduce herewith a number of cuts suggestive of Christmas possibilities in the way of electrical presents for children. The cuts, of course, are only typical and represent the merest fraction of what is available nowadays. It is high time, however, that the dealer should make his choice and place his orders, as the next two months will roll away very quickly. In spite of the war and other depressing coditions, it is doubtful if Canadian children will find themselves much neglected when they come to examine their stockings on Christmas morning. It is reasonable to expect, however, that the tendency will be towards purchases of more useful gifts and this is just where the electrical toy and all the other efficient electrical appliances will have a chance to demonstrate their particular applicability. Merely as suggestive, we publish a list below of toys and novelties any one of which may well find a place on the list of every father and mother starting out to make their Christmas purchases.

Telegraph instruments
Wireless outfits
Permanent magnets
Electric motors
Flash lights
Christmas tree outfits
Electric automobiles
Radioptican
Utility motors
Electric tops
Rotary transformer
Electric railway accessories
Electric hoists
Electric windmills
Electric vibrators
Flash lights
Electric signals
Electric pen illuminater
Ferris wheel
Toy X-ray outfit
Toy water power plant
Storage batteries
Electric bicycle lanterns
Medical batteries
Electric magnets
Electric bells
Electric dynamos
Miniature railways
Toy transformers
Electric aeroplanes
Electric switches
Electric questioner
Electric power houses
Electric locomotive
Electric lamps
Electric derricks
Electrically-operated bridges
Electric night clocks
Electric flying machines
Electric scarf pins
Aerial swing
Merry-go-round
Miniature static machine
Electric corn popper
Dry cells

Outside of the field of mere toys, the list of Christmas presents which may well be offered to the judicious purchaser during the next couple of months is a very lengthy one. In the hope that it may prove of assistance, we print a fairly complete list below. There is no single item mentioned that will not take its place in the daily life of a man or woman, adding both pleasure and comfort. It would scarcely be possible to compile any other such list of suggestions that would compare with it in utilitarianism and luxury.

For Women

Bed Warmer
Cosmetic heater
Comb and curling iron
Curling iron
Hair dryer
Hair singe
Heated comb
Massage vibrator
Smoothing glass
Bed and boudoir lamp
House lamp
Battery candle
Candelabra
Floral decorations
Illuminated mirror
Illuminated table ornament
Bungalow portable
Cut glass portable
Indirect lighting portable
Mission portable
Reed or wicker portable
Piano lamp
Reading lamp
Table lamp
Writing desk lamp
Casserole
Chafing dish
Coffee pot
Coffee urn
Chocolate warmer
Immersion heater
Percolator
Samovar
Saute pan
Teakettle
Toaster
Toaster stove
Griddle
Water cup
Water heater
Broiler
Cereal cooker
Combination cooker
Cook stove
Disk stove
Egg cooker
Fireless cooker
Flat iron

(List continued on page 49)

Fig 1 Toy transformer operating train, grindstone, circular saw and other machinery. Thordarson Electric Manufacturing Company, Chicago, Ill.

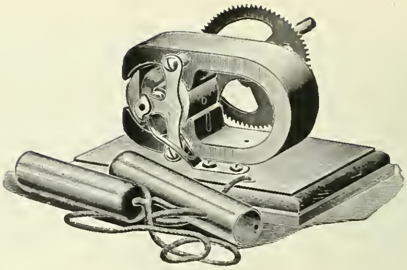


Fig. 2—Electric thriller magneto, hand-operated.—Knapp Electric & Novelty Company, New York.

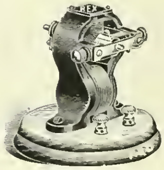


Fig. 3—Rex motor, operates on one cell, size 3 by 3½ by 3½ inches.—Kendrick & Davis, Company, Lebanon, N.H.

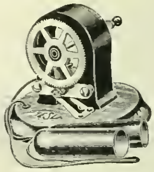


Fig. 4—Tesla magneto-electric machine, operated by crank.—Kendrick & Davis Company, Lebanon, N.H.

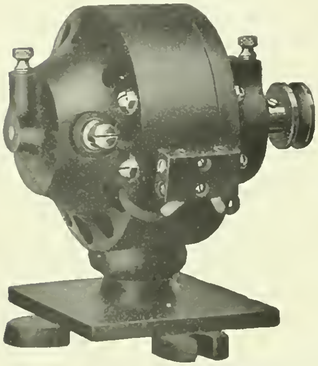


Fig. 5 1/30 h.p., 110 volt motor, consumes 35 watts. Menominee Electric Manufacturing Co., Menominee, Mich.

Fig. 6 Christmas tree lamp outfit. Import Sales Company, New York.

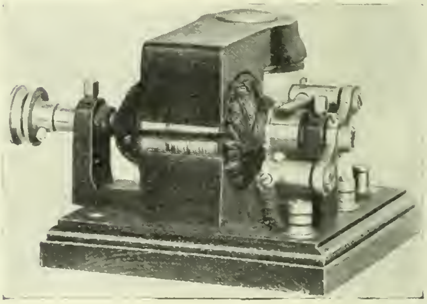


Fig. 7—Motor or generator, 16-18½ volts, height 4 inches.—Menominee Electric Manufacturing Company, Menominee, Mich.

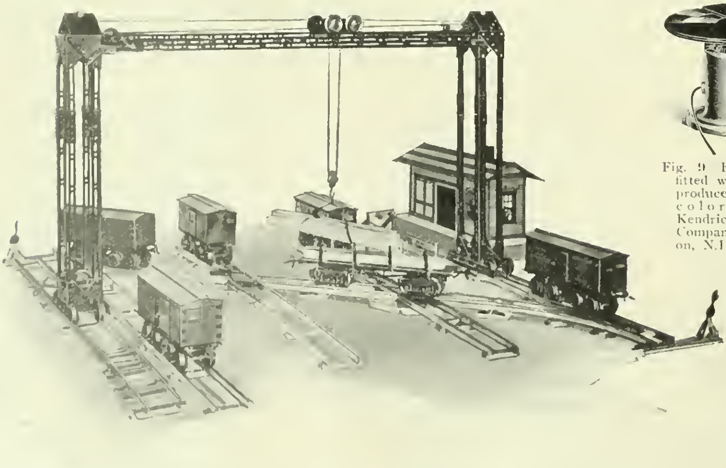


Fig. 8 Electrically operated train yard with derrick for loading and unloading. Ives Manufacturing Corporation, Bridgeport, Conn.

Fig. 9 Electric top, fitted with discs to produce beautiful color effects.—Kendrick & Davis Company, Lebanon, N.H.

Fig. 10—Safety First hand lamp, operated by standard dry battery, throws light on ground, burns 40-60 hours.—Federal Sign System (Electric), Chicago, Ill.

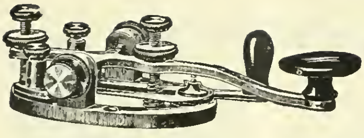


Fig. 11—Legless telegraph key for beginners.—Menominee Electric Manufacturing Company, Menominee, Mich.

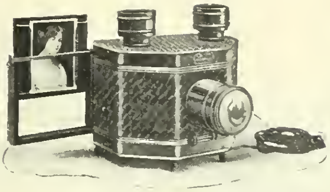


Fig. 12—Electric Radioptican, shows post cards or larger pictures in natural colors.—H. C. White Company, North Bennington, Vt.

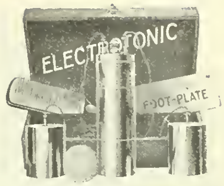


Fig. 13—Electrotonic outfit complete, weighs three pounds.—Stanley & Patterson, Inc., New York.

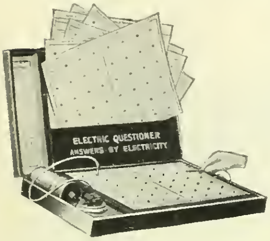


Fig. 14—Electric questioner, answers by electricity.—Knapp Electric & Novelty Company, New York.

Fig. 15—Toy transformer, voltages 6-9-15, capacity 60 watt.—Dongan Electric Manufacturing Company, Detroit, Mich.

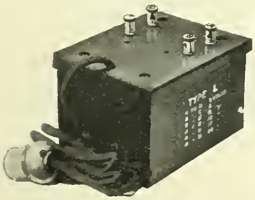


Fig. 16—Toy transformer, voltages 3-5-8-12-17-20 volts, capacity, 60 watts.—Lionel Manufacturing Company, New York.

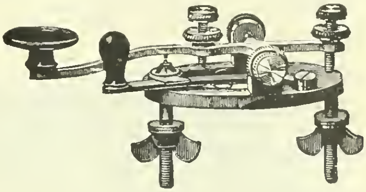


Fig. 17—Same as Fig. 11, but with legs.—Menominee Electric Manufacturing Company, Menominee, Mich.

Fig. 18—Toy transformer, voltages 7-11-14-17-20-24, capacity 120 watts.—Dongan Electric Manufacturing Company, Detroit, Mich.

Fig. 19—Magneto-electric machine, for electro-medical work.—Stanley & Patterson, Inc., New York.

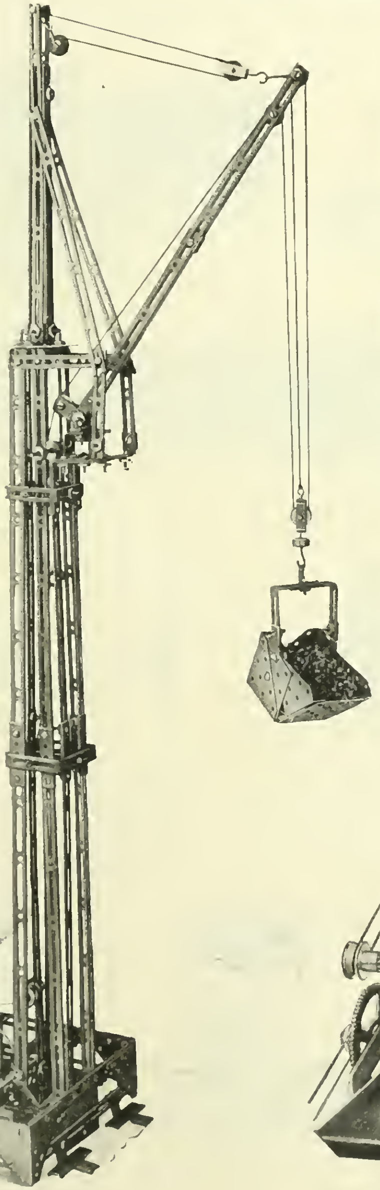


Fig. 20—Electric derrick, 31 inches high.—Ives Manufacturing Corporation, Bridgeport, Conn.

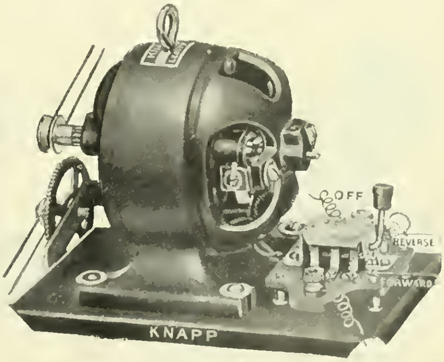


Fig. 21—Driving motor, equipped with starting and reversing switch.—Knapp Electric & Novelty Company, New York.

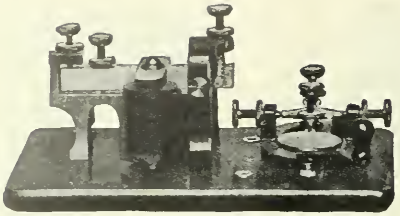


Fig. 22—Junior learner telegraph set.—Menominee Electric Manufacturing Company, Menominee, Mich.

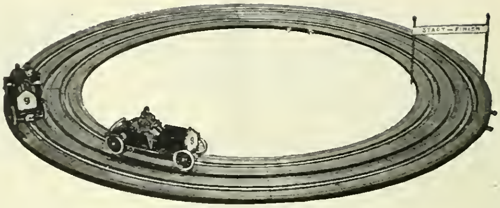


Fig. 23—Electric automobile race track, operates from toy transformer or by battery.—Lionel Manufacturing Company, New York.

Fig. 24—Curtiss Biplane, planes 12 inches long, operates on 4-6 dry batteries or toy transformer and travels in a circle 3-25 feet in diameter.—A. E. Rittenhouse Company, Honeoye Falls, N.Y.

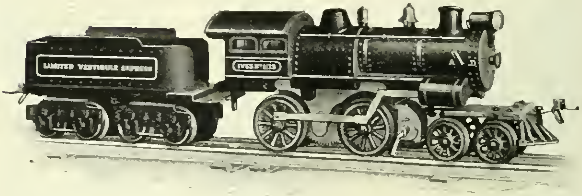


Fig. 25—Electric locomotive, 8¾ inches long, with reverse.—Ives Manufacturing Corporation, Bridgeport, Conn.

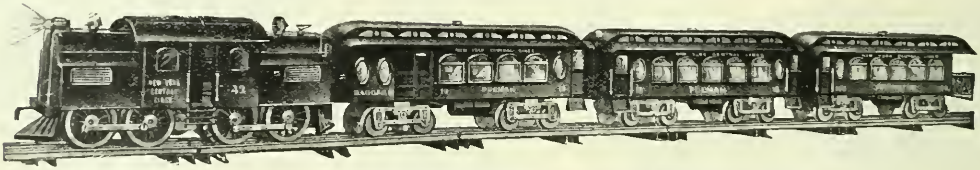


Fig. 26—Electric train 5 ft. 5 in. long, electric head-light and illuminated cars.—Lionel Manufacturing Company, New York.

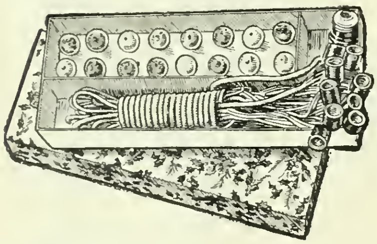


Fig. 27—Set of lamps for Christmas tree decoration.—Import Sales Company, New York.

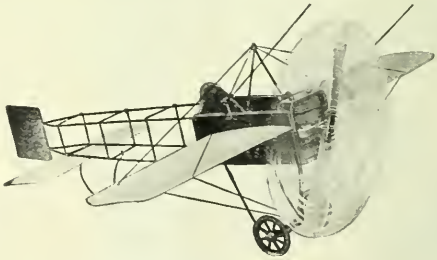


Fig. 28—B'eriot monoplane, spread of planes 22 inches, travels in circles 5-100 ft. in diameter at 12 miles an hour on 8 dry batteries.—A. E. Rittenhouse Company, Honeoye Falls, N.Y.

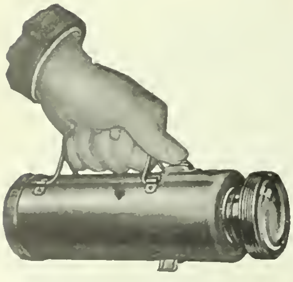


Fig. 29—Handy flash light, accommodates standard dry cell, operates for 50 hours.—Beers Sales Company, Bridgeport, Conn.

Fig. 30—Little Hustler motor, runs on dry cell, fitted with pulley for driving toys.—Knapp Electric & Novelty Company, New York.

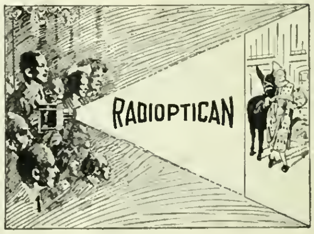


Fig. 31—Radioptican, a highly enjoyable and instructive form of entertainment.—H. C. White Company, North Bennington, Vt.

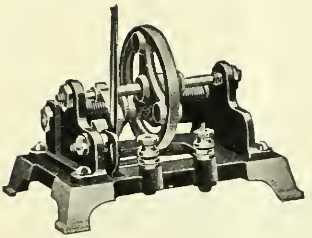


Fig. 32—A powerful little motor which operates on one dry cell, reversible—H. K. Electric Toy Company, Indianapolis, Indiana.

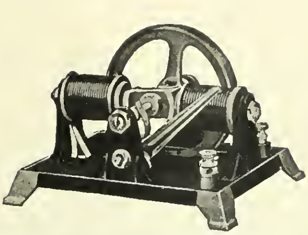


Fig. 33—2 pole type motor for operating toys, body of motor red, trimmed with gold, operates on one dry cell—H. K. Electric Toy Company, Indianapolis, Ind.

Fig. 34—Powerful toy transformer — Thordarson Electric Manufacturing Company, Chicago, Ill.

Fig. 35—110 volt 60 cycle transformer, delivers 10 and 12 volts—Ives Manufacturing Corporation, Bridgeport, Conn.

Fig. 36 — Electric candle, batteries concealed within the candle. Tungsten lamp J. H. Bunnell & Co., New York.

Fig. 37—Ever Ready flashlight—Northern Electric Company, Limited, Montreal.

Frying pan
Grid
Grill
Hot closet
Oven
Plate warmer
Domestic range
Table range
Table cooking set
Waffle iron
Battery lantern
Bell ringing transformer
Candelabra lamp
Chimes and bells
Dish washer
Home ironing machine
Vacuum cleaner
Washing machine
Kitchen cabinet
Ozonator
Perfumer and disinfector
Radiator
Sewing machine motor
Traveling iron
Traveling stove
Utility motor
Automobile (electric)
Limousine telephone set

For Men

Battery lantern
Bed foot warmer
Bicycle lamp
Hand lamp
Cigar lighter
Electric scarf pin
Electric watch charm
Flashlight cane
Pistol flashlight
Pocket testing meter
Drink mixer
Hair singe
Illuminated mirror
Shaving mug
Shaving glass and lamps
Silk hat iron
Traveling iron
Traveling stove
Vibrator
Water cup
Alarm clock
Reminder clock
Bed lamp
Chair lamp
Floor portable
Table or reading lamp
Automobile battery lamp or lantern
Automobile foot warmer
Automobile trouble lamp
Chest of automobile lamps
Glove, auto signal or electrically heated
Electric horn
Traveler's lamps, cord and plug

For Older People

Electric bath cabinet
Foot warmer
Heating pad
Medical battery
Medical coil
Nurse signal
Ozonator
Perfumer and disinfector
Vaporizer
Ozone blanket
Radiator
Sterilizer
Vibrator
Violet-ray apparatus
Chocolate warmer
Egg cooker
Immersion heater
Milk bottle, or food warmer
Toaster
Toaster stove
Water cup
Water heater
Battery candle
Ceiling clock
Electrically-lighted table clock
Bed lamp
Regulating lamp or socket
Hearing device

Telephone Systems

The Ontario Railway and Municipal Board are distributing copies of "Telephone Systems," which includes the text of the Ontario Telephone Act and amendments to date; extracts from report of the Ontario Railway and Municipal Board for 1913; specifications for the construction of telephone systems; forms of petition and by-law for telephone systems established under part 2 of the Ontario Telephone Act, etc. The Board will be pleased to mail a copy of this pamphlet to any person sufficiently interested in telephone matters to make application.

The pamphlet tabulates a summary of the returns from 463 telephone companies, municipalities, and individual owners of telephone lines in Ontario up to December 31st, 1913.

Nairn Falls Power Co.

The Nairn Falls Power Company, Limited, 811 Rogers Building, Vancouver, is making application for a license for the storage of 100,000 acre feet of water out of the Soo River which flows westerly and drains into Green River about one half a mile south of the southern end of the Lillooet Land Recording District. The water will be used for power purposes.

Effective and Inexpensive

The James Corr Electric Company, of Omaha, have hit upon an effective form of retail advertising that costs comparatively little, keeps them in touch with the prospective purchaser all the time, and has been found to give good results. Each month this company issues some 6,000 blotters, the colors being varied from month to month so as to distinguish them, at an expense of about $5 per thousand. This includes printing and delivery by carrier to all the principal business houses in the city. Unlike the average blotter, which would contain little more than the name and address of the firm distributing them, these blotters each month are covered with useful hints and suggestions on the wiring of your house or the use of electrical supplies of various sorts. Interspersed with these informing items are a number of more or less humorous paragraphs, which help

further to emphasize the name of the firm and to keep the blotter in the mind of the reader.

As indicating the type of information distributed each month in this way, we print below the blotter of September 15th, 1914, which Mr. Corr has been good enough to send us. We believe the idea is a very excellent one and may well be followed by many Canadian jobbers who at present may have difficulty in getting in touch with as many customers as they would like. Reaching a customer with a direct message which stays with him during the month at a cost of only half a cent is cheap advertising.

THE BLOTTER

Vol. I. OMAHA, SEPTEMBER 15, 1914 No. 9

Published 15th of Month at 205 So. 19th St. for the benefit of the James Corr Electric Company

Entered at Business Offices as First-class Blotting Matter

Subscription Rates, a Request. Call Doug. 4466

Circulation, All Over the Desk

OUR MOTTO: RELIABLE WIRING

See us for latest designs in Lighting Fixtures. Our prices are right.

Some matrimonial bonds are very good dividend payers.

The motor business has continued good this month with 1-25HP, 2-20HP, 1-10-HP and 2-5HP with several small ones. Even our little place makes the Jobbers envious of our motor sales.

Many a fine blacksmith has been spoiled because a fond mother imagined he had musical talent.

The Starr-Kingman Shoe Co. have a nice new window which is the finest display window west of Chicago. This window must be seen to be appreciated and would advise that you stop when down that way and look it over. Of course, the electric work was furnished by the James Corr Electric Co.

Two Irishmen coming to the United States were shipwrecked on the way. Mike swam safely to shore and immediately after turned and started to run back into the water.

Bystander — "Where are you going, Mike?"

Mike — "I've saved myself. Now I'm going back to save Pat."

We have a new charging plant for electric automobiles, which is bound to be a winner, as it does away with the expense and annoyance of the rectifier and is far more efficient and the cost is not as great. They have the advantage of being absolutely fool-proof and cannot get out of order. If you contemplate installing anything of this kind, we would advise that you see us. Call us at Douglas 4466, and we will be very glad to demonstrate this plant.

And you can borrow trouble on darn poor Collateral.

How about your Dry Batteries? We handle the Columbia No. 6, which is absolutely guaranteed to be the best battery in the world, without exception. Stop and see us for your requirements.

Many a man has smashed his own thumb nail when he started out to "nail a lie."

By installing our Mazda Lamps in all rooms in one of the largest hotels, the proprietor has cut his bill almost two-thirds and the guests are much better satisfied with their light. Stop in and get a carton for trial. All lamps absolutely guaranteed.

Ask us about the use of transformers on your bell systems—does away with batteries — insures satisfactory and lasting service.

We are placing Flash Lights at the very reasonable price of 75 cents for the entire outfit and the very best large styles on the market for $1.25. At these prices, no one can afford to be without one for emergency use.

Two Irishmen, meeting one day, were discussing local news.

"Did you know Jim Skelly?" asked Pat.

"Faith," said Mike, "an' I do."

"Well," said Pat, "he has had his appendix taken away from him."

"Yez don't say so," said Mike. "Well, it serves him right. He should have had it put in his wife's name."

D. C. Cable Testing Ammeter

The Metropolitan d.c. cable testing ammeter is so designed as to measure the current in a conductor without either disturbing or open-circuiting the same. This instrument is ready for immediate use by removing the "U" shaped iron strap, placing the conductor within the loop of same and re-installing the strap to the instrument terminals. It will then indicate the current flowing in the enclosed conductor when the key controlling the moving coil circuit is pressed. This instrument resembles in principle those of the D'Arsonval type excepting that the permanent magnet is replaced by the detachable iron loop and the moving coil circuit is energized by a small auxiliary battery. It will be readily seen that when the iron loop encloses a conductor carrying current, the flux in the magnetic circuit of the instrument will be proportional to the current flowing in the

conductor and as the moving coil is independently energized by a current of constant value the deflections of the pointer on the scale will be proportional to the current flowing in the conductor.

This instrument will be found to be extremely useful for such purposes as the measurement of current in direct current networks, loads on house or service wires, bus bars, etc., where it is found to be inconvenient or impossible to open the conductor for the series connection made necessary by the ordinary ammeter. This instrument occupies a place in direct current measurement which is identical with that of the portable split-core current transformer and ammeter as used in alternating current measurements. It will be found of special value in the supervision of networks where the distribution of load from feeding points and the balancing of the system have to be checked at frequent intervals. Measurements of this nature with ordinary instruments would, in many cases, be so expensive as to be prohibitive, and for this reason in the majority of cases, these measurements, while desirable, are not made, the distribution being a matter of guess-work. The Metropolitan d.c. cable testing ammeter makes it possible to take such measurements rapidly and at comparatively small expense. The instrument is compact, weighing only 4½ lbs. It is substantial, simple in design and may be handled and calibrated by the ordinary workman as this calibration simply consists of having a conductor of known value inserted in the loop and a few simple adjustments made. Should the instrument at any time become out of adjustment, this may be regulated by means of a small regulating resistance provided in the moving coil circuit whereby the current in the moving coil

may be adjusted until the instrument corresponds to the current to be measured.

An Interchangeable Sign

The Canadian Steel Products Company, Limited, Montreal, have just put on to the market an interchangeable sign entirely made in Canada. Fig. 1 shows the standard 25-letter space sign. For each sign there are 125 slides or glasses,

Fig. 1—Interchangeable sign of the Canadian Steel Products Co.

comprising the alphabet, numbers, characters, and blanks, the letters which are more frequently used, such as A and E, being duplicated, so that any advertisement or word desired can be formed. The advertisement can be changed at will, which is one of the great advantages claimed for this character of sign. The letters, 4 in. high, are left clear on the glass, and the black painted around the letters. The opaque glass is always left in the grooves, and consequently when the letter is slid over the opaque glass all that is seen is the white letter against the black background. The frame

Fig. 2—Sign of different size and shape.

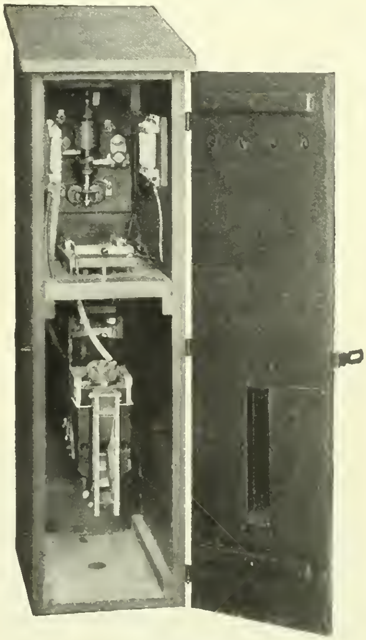
of the sign is of steel, electro-plated gun metal, giving it the highest of finishes and durability, not attained in any other kind of frame. The sign box is of galvanized iron painted on the inside with reflecting aluminium paint, and has tungsten lamps wired with motorless flasher. There are 10 feet of reinforced cord with attachment plug for its connection. It is claimed that this combination makes the most effective night sign ever designed for window or indoor advertising. The sign can be hung up by chains, and is so arranged that

Fig. 3 Small but effective sign.

the box can be left and only the frame removed to change its wording. This saves re-dressing a window, and enables another show card to be displayed without cost. The signs can be manufactured in any style, containing any number of grooves or number of lines. This gives the jobber or contractor the opportunity of complying with the requirements of any store, advertiser, or manufacturer. A strong point is made, by the makers, of the adaptability of the sign, which can be easily adjusted. The company are also makers of "Cansteel" products, cutout and panel boxes, cabinets, steel shelving, racks, steel lockers, etc.

A New Sectionalizing Switch

A new automatic sectionalizing switch with a continuous capacity of 800 amperes and adjustable for overloads of 600 to 1200 amperes is offered by the Canadian General Electric Company. This switch will equalize the voltage on all sections of a trolley line, thus taking care of overload conditions with a consequent improvement in service. An overload trip and automatic reset feature greatly increases the efficiency of the device. The switch is mounted in a long, narrow box conforming to the trolley pole on which it is to be installed. With this switch, an overload or short cir-



Sectionalizing Switch.

cuit on the line throws out only the station breaker feeding the section affected, thus avoiding interruption of service on the other sections. When the trouble is remedied and the station breaker again thrown in, all the switches on the line automatically close, once more desectionalizing the system. It is equally applicable to trolley wire or third rail systems and will enable companies to improve their operating conditions without the large outlay for feeder copper generally necessary.

The "Autosign"

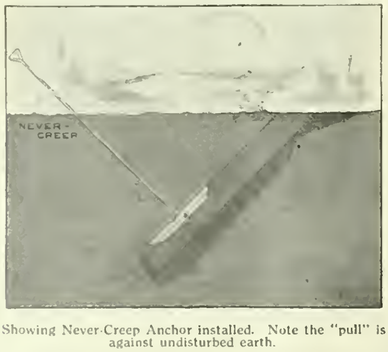
"The Autosign" is an interchangeable electric sign for window and show case advertising, invented by Mr. Morton Wright, of Montreal, the sole Canadian selling rights for which are held by Roper, Clarke & Company, Limited, Montreal. In addition to the usual features of interchangeable signs, it is pointed out by the makers that it possesses two others which are of interest—it is brilliantly lighted, and is, by reason of being made in Canada, much cheaper than imported signs. The Autosign has a white plate glass mounted in a polished ebony frame. The white plate contains grooves

Interchangeable sign of Roper, Clarke & Co.

into which are fitted pure rubber letters; a plain glass is then drawn over the letters, giving the whole surface a finished appearance. One hundred letters and figures are supplied with the sign—other letters may be bought at 10c each if needed. Eight feet of cord, tungsten lamp and flasher are also supplied with the outfit. The letters are made of unbreakable rubber, and will last indefinitely. The cost of running the sign is as follows: ten hours per day at 7c per kilowatt, $8.40 per year; ten hours per day at 5c per kilowatt, $6.00 per year; at 3 cents per kw. $3.60, and so on. The style shown in the illustration is 10 x 16 inches, but any size of sign can be supplied by the distributers.

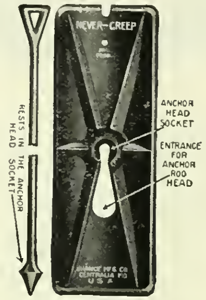
The New "Never Creep" Anchor

The Electric Service Supplies Company has entered into an exclusive selling proposition with the Chance Manufacturing Company to push the sale of the latter company's



Showing Never-Creep Anchor installed. Note the "pull" is against undisturbed earth.

"Never Creep" anchors. This anchor is the result of efforts to combine in one anchor all of the good features of the "dead-man" and the many other anchors on the market. In the accompanying illustrations, note that the design of this anchor makes possible the method of installation, i.e., the fact that the "pull" is against undisturbed earth which does not allow the anchor to creep. The anchor itself consists of two separable parts—the anchor rod and anchor plate. The anchor rod is of from one-half to one inch steel, depending on size of anchor, and is so designed to be easily driven through the undisturbed earth. The anchor plate is curved and reinforced and is of cast iron. In size, the plates range from 3½ x 10 inches to 11 x 40 inches, depending on size of anchor required. All parts are treated to effectively withstand the action of rust. The anchors are installed by boring a hole (preferably with an auger) at as near a right angle to the line of strain as conditions will allow. The anchor rod



Never-Creep Anchor Rod and Plate.

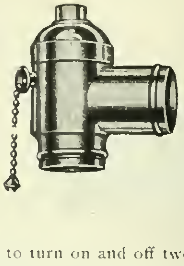
Tamping Bar with special end fitting for lowering plate into hole.

is then forced down through solid earth, by driving, stopping the head of the rod about the centre of the hole. After the anchor rod is installed, it is only necessary to lower the anchor plate into the hole, by means of a special tamping bar, engaging socket in plate with head of rod, then to pull up on rod and the anchor is ready for service.

Twin Pull Sockets

Pull sockets with outlets for two lamps are being made by the Bryant Electric Company, Bridgeport, Conn. An attachment plug, of course, may be substituted for one lamp or two attachment plugs may be used instead of two lamps.

This socket is made in two types. In one type both outlets are simultaneously put on or off by successive pulls of the chain. In the other type the straight outlet alone is affected when the chain is pulled, the lamp in the angle outlet being on all the time. The first type is useful where it is desir-



able to turn on and off two energy-consuming devices at the same time or where one outlet holds a lamp which serves as a pilot lamp for an appliance connected to the other outlet. The second type is useful when it is desired to have a lamp or other energy-consuming device equipped with its own switch connected to the angle outlet. A shade holder can be attached to either outlet and can be held in its normal position relative to the lamp.

New enclosed reversing switch for squirrel cage motors arranged for rope operation.

Reversing Switches for Squirrel Cage Motors

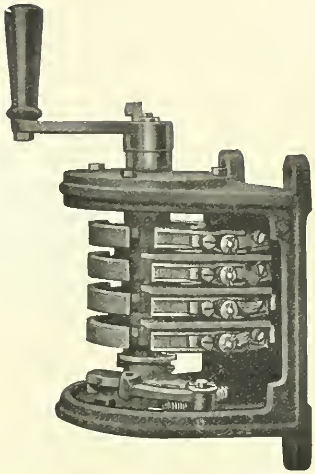
The enclosed drum type reverse switches recently developed by the Cutler-Hammer Mfg. Co., Milwaukee, are designed for the reversing of small polyphase induction motors that may be thrown across the line in starting. As shown in the accompanying illustration provision is made for operating by means of a rotary handle or by means of ropes. In the latter case the drum switch may be installed out of reach, and in a position the reverse of that shown. This type of reverse switch is also adapted for use on small a.c. elevator equipment driven by high resistance rotor squirrel cage motors. The enclosing case protects the switch contacts from dust and dirt, and prevents accidental contact of the live parts by the operator or workman.

The Advertogram

The "Advertogram" is a patented device for day and night use in show windows, the principal feature of which is that the reading matter can be changed in two minutes by sliding each letter separately into compartments. The letters are clear glass with black background, each letter being backed with a sheet of pure white opal that makes the "Advertogram" a wonderful day sign without being illuminated—a sign that can be read very plainly from the opposite side of the street. It is all metal, fifty inches long and seven inches high, illuminated with four 25-watt lamps that are flashed intermittently by a motorless flasher. The "Advertogram" has a black gun metal frame that adds tone, yet simplicity, to the highest class show window. Retail merchants, such as shoe stores, haberdashers, hatters, grocers, drug stores, etc., are the people to whom such a sign will appeal, because the merchant is then in a position to write his own show cards and the flashing of the sign attracts the attention of the passers-by on both sides of the street. This "Advertogram" is not only adapted for use in the show window, but is being used extensively by departmental stores to indicate the various departments or special sales of the day. Moving picture theatres are also using the "Advertogram" to announce coming and daily attractions. The Northern Electric Company are the exclusive Canadian selling agency for the "Advertogram," and they report a big demand from all parts of the country.

Interchangeable sign of Northern Electric Company, Limited.

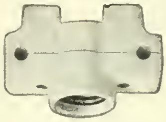
Net earnings, for the first seven months of the year, of the Winnipeg Electric Railway Company, are $1,030,124. It is a remarkable coincidence that the earnings for the same period a year ago were $1,030,121.



Cutler-Hammer reverse switch for induction motors (cover removed).

Decorative Outdoor Receptacle

The illustration herewith shows a new outdoor receptacle designed by the H. T. Paiste Company for use on the Garden Pier, Atlantic City. They have very plain yet graceful lines, and suit admirably the style of architecture. They were glazed a dark brown to harmonize with the tiling. The

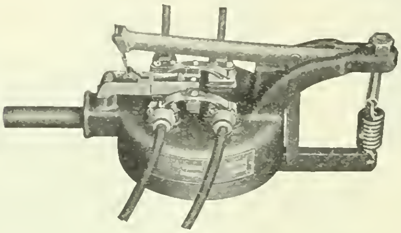


binding screws are well protected, and are centre spaced so that both wires may be bared at the same place. The wires are carried one inch above the surface wired over. Drip holes are provided from the screw shell. The centre contacts are of phosphor bronze.

Automatic Pressure Switch

It is frequently desirable to be able to control automatically a motor pump for hydraulic or pneumatic water systems and vacuum systems and for this purpose the Canadian General Electric Company offer the automatic pressure switch shown here. This switch is positive in operation and will open or close at the predetermined pressure without sticking or jamming of any kind. It will stand a pressure of 200 pounds without damage and bears underwriters' approval for 10 amperes at 250 volts or 20 amperes at 125 volts. For heavier service the switch is used in relay circuit which controls the motor starter. The construction of the switch is as follows: The bottom of a cup or pan shaped body casting is closed by a flexible phosphor-bronze diaphragm and on the top of this casting is mounted the switch mechanism. As the position of the diaphragm is varied by the internal pressure, its motion is communicated to the switch mechanism which in turn causes the switch

contacts to open and close when certain ranges of movement of the diaphragm are reached. The switch proper is of a double pole, quick break construction, its design following closely that of heavy current capacity circuit breakers. The current carrying parts are exceptionally heavy and take care



Pressure Switch.

of severe overloads. The connecting cables are all fastened directly to the stationary contacts eliminating the necessity of flexible connection to moveable parts of the switch.

Valuable Home Service

The employees of Siemens Brothers Dynamo Works have responded with great enthusiasm to the call to arms. A large number of men from their works and offices at Stafford, amounting in all to about 400, have already joined the forces, and, together with the reservists and volunteers from their head office, branch offices and other departments, the total amounts to over 520. The firm is arranging to keep the posts of all these men open, and ample provision is being made for all the dependents of those who have gone to serve.

Can't Beat Them

The stability of the modern tungsten lamp is well illustrated in an incident which occurred in Toronto a few days ago. The occupant of a second storey purchased a case of 250-watt nitrogen filled lamps of well known manufacture, and turned these over to an attendant, a careless one, as he proved afterwards, for attention. This attendant, believing he had removed all the lamps, bundled the empty cartons into the box and rolled the box out of the window to the courtyard below, where it lit on a stone and bounced and rolled several feet. Quite by accident, the proprietor later discovered that two of the cartons still contained lamps, and was much surprised on removing them, to find them absolutely uninjured.

C. H. Basters & Company, importers and dealers in electrical supplies, Toronto, state that last month's sales were the largest in the history of the company. Mr. Basters is at present in Holland on a purchasing trip.

Some Effects of War on Trade in England

It has been customary prior to the war with Germany for large quantities of electrical apparatus and appliances for use in Great Britain to be purchased, not only in the completed form, but in parts, from Germany. This has always been a cause of complaint by the manufacturers of such electrical apparatus and appliances in the United Kingdom. Shortly before the war several large contracts were made, so it was reported, with German factories for installation in Great Britain. As these appliances are required without delay, it is expected that the contracts for the same will now be given to British makers, the war having broken the other contracts. It is interesting to remember that two of the largest factories for making electric generating plants, and so forth, in the United Kingdom are branches of American companies. It is calculated that the war will lead to the placing, even after it is ended, of a very large proportion of such contracts as previously went to Germany and Austria with manufacturers in Great Britain, thus resulting in a permanent business for the British makers.—(Daily Consular and Trade Reports).

The Dominion Government Building, formerly supplied with light and power by the Winnipeg Electric Railway Company, is now being served by the City Light & Power Department.

Trade Publications

Turbo-alternators—Circular No. 506 issued by the Railway and Lighting Department of the Canadian Westinghouse Company, describing Westinghouse turbo-alternators.

Steam Engines—Bulletin 128, issued by the Canadian Allis-Chalmers, Limited, describing Chandler-Taylor steam engines built for direct connection to electric generators.

A Study in Contrasts—folder issued by the Ohio Brass Company, Limited, illustrating and briefly describing several examples of evolution in electric operations owing to the use of O. B. material.

Dim-a-lite—Catalogue issued by the Wirt Company, describing and illustrating their complete line of Dim-a-lites and their method of operation together with a brief description of their mechanical construction.

"Service"—a very attractive booklet issued by the Robbins & Myers Company, Springfield, Ohio, describing in some detail the methods adopted by this company and the care taken in the manufacture of small motors for motor-driven machines of various sorts.

Electric Heating—a booklet issued by A. Schonfield, 21 Hope Street, Glasgow, describing the Grundy system of automatic temperature control and the Hestia electric stoves. The booklet contains much new and interesting information about the latest and most scientific methods of heating and ventilating by electricity.

Westinghouse Publications—The Westinghouse Electric and Manufacturing Company are distributing a number of interesting publications having special reference to electric railway work. These include special publication No. 1552, which outlines the progress made by the Westinghouse organization in the electric railway field during the past year. The October number of the Westinghouse Railway Data Exchange also contains interesting information along the same lines. Circular No. 1546 is a collection of illustrations, with brief notes, showing some of the advantages of multiple-unit trains in city, suburban and interurban service. Publication No. 1549 contains a number of interesting and attractive illustrations, showing operating conditions in many large traffic centres. Circular No. 1550 describes Westinghouse 1500 volt direct current sub-station equipment.

C. G. E. Publications—Bulletin 48,700, describing and illustrating Sprague electric monorail trains. Data book, describing new fixtures and fittings for multiple mazda lamps, issued by the Holophane Works of the General Electric Company. Catalogue No. 311, describing the counter-line of Holophane-D'Olier metal reflectors. Bulletin F, describing Wheeler multiple mazda fixtures for type C gas filled lamps. Booklet describing the type X Exide battery, for automobile starting and lighting service. Catalogue 11, describing Hart & Hegeman 600-volt switches. Booklet No. 906, describing electric hoists for the efficient handling of all loads. Bulletin No. 43,320, describing type W flame arc lamps for series and multiple circuits. Publication 507, describing small capacity, standard unit switchboard, d.c. up to 575 volts. Publication 508, describing type R domestic electrical ranges.

Current News and Notes

Burford, Ont.

By-law was passed October 9th, authorizing expenditure of $5,000 on a hydro-electric distributing system.

Calgary, Alta.

The Alberta Government is being petitioned to extend their telephone line to the Dingman Camp, where it is suggested that a central exchange be installed with telephone lines radiating to the various oil drilling camps.

Canso, N.S.

The Corporation electric lighting plant was put into operation this month. The plant consists of one 95 h.p. single cylinder gas engine with producer and accessories; one 62 kv.a., 60 cycle, 2300 volt, 1200 r.p.m. generator with exciter and panel, and one 8 kw., 4 ampere c.c. transformer. The streets are wired for 80, 60 c.p. series 4 ampere lamps. The entire plant was furnished and installed by the Canadian Allis-Chalmers Company.

Chatham, Ont.

A by-law providing for an expenditure of $90,000 for the installation of a sub-station and distributing plant in Chatham was carried by a majority of 938 out of a total of 1268 votes cast.

Cornwall, Ont.

The ratepayers on October 14th carried a by-law extending the franchise of the Cornwall Street Railway, Light and Power Company for a period of twenty years.

Danville, Que.

Extensive improvements are being made in the boiler house of the Danville Electric Light Plant.

Elora, Ont.

Hydro-electric power was turned on in this town on October 22nd. Elora was formerly supplied with light and power by the Fergus Electric Light Company.

Fort William, Ont.

The new belt line was opened for traffic on Tuesday, October 13th. The event was celebrated by giving free rides throughout the whole day to any citizens who cared to patronize the line.

Galt, Ont.

The Water Commission are considering the installation of a gasoline-engine-operated auxiliary pump for emergency use.

Goderich, Ont.

The Goderich Town Council will ask the Hydro-electric Power Commission of Ontario to have their engineers report on the completion of the Ontario West Shore Railway and its operation as a part of the Hydro-Radial System.

Hamilton, Ont.

Tenders have been received by the Public Utilities Commission of Hamilton for the erection of a sub-station on the town hall site.

The Hamilton Board of Control will make application to the Hydro-electric Power Commission of Ontario for a report on the cost and probable receipts of the Hydro-Radial line from Georgian Bay to Guelph to Hamilton. The scheme has met with considerable favor in the district to be served by this prospective line.

London, Ont.

Following the favorable Hydro-Radial vote in central Ontario, interested parties are agitating for the submission of a by-law in January authorizing the construction of a line connecting the Stratford City line and the London and Port Stanley system. An increased activity is noticeable in other towns of southwestern Ontario as well.

It is understood to be the hope of the London & Port Stanley Railway Commission to have the electric equipment installed and the road electrically operated by May 1st, 1915.

Medicine Hat, Alta.

The Hudson Electric Company are busy installing a complete electric lighting system and some power work for the Maple Leaf Milling Company. This is a six-storey building and will require about 300 lamps. All work is run in conduit.

Montreal, Que.

Directors of the Montreal Light, Heat and Power Company have declared their regular quarterly dividend of 2½ per cent., payable November 16th to the shareholders of record October 31st. The earnings of this company for the first four months of their fiscal year showed a gain of some 8 per cent. over the corresponding period a year ago.

It is now said that Sir Rodolphe Forget is the real purchaser of the plant of the Eastern Canada Power & Pulp Company, the transfer of which was recently made for the sum of $200,000.

Alcidas Galipeault and Dominique Boisvert have registered as electricians.

Although a fair amount of work on the Cedars Rapids Manufacturing and Power Company's plant remains to be done, it is certain that the company will be in a position to supply current at the beginning of the year. The contractors, Fraser, Brace and Company, have completed the power house and the canal, and the heavy machinery has been installed. Work is being continued on the two transmission lines, one to Montreal and the other to Massena, N.Y., and indications point to the former being completed in two weeks' time.

The Cedars Rapids Manufacturing and Power Company have issued their fourth progress-report, dealing with the construction work on their generating plant to date.

Roper, Clarke and Company, Limited, Montreal, representing the Premier Accumulator Company, Limited, Northampton, Eng., have completed the installation of a 57 cell battery in connection with the automatic signalling system just put into use by the Grand Trunk Railway on the Victoria Jubilee Bridge, Montreal, and its approaches. This system was fully described by Mr. R. F. Morkill in our issue of September 15.

Mr. G. M. Gest has been admitted to the membership of the Montreal Board of Trade.

Moncton, N.B.

The Moncton Tramways, Electricity and Gas Company put into operation, this month, their new motor-generator set. It consists of one 200 kw., 550 volt, d.c. railway generator direct coupled to a 3-phase, 60 cycle, 1100 volt motor, 900 r.p.m. The outfit was supplied by the Canadian General Electric Company.

Orillia, Ont.

Superintendent Greenwood has recommended the immediate expenditure of the sum of $700 to improve the distribution and lighting system.

Peterborough, Ont.

The Utilities Commission has accepted the offer of the Hydro-electric Power Commission of Ontario to sell second-hand C. G. E. and Westinghouse meters at the price of $4.10 each. These are 60-cycle meters taken from towns in the Hydro area that have been changed over from 60 to 25 cycles.

Port Arthur, Ont.

The pump house of the municipality of the city of Port Arthur, formerly located at Current River, is being removed to the northern city limits, where a new intake is being installed. The city is also erecting at this point a high-tension sub-station 25,000/2,200 volts for the operation of this and other plants likely to locate in the neighborhood. They have also built during the summer a low tension, 2,200 volt line connecting the Current River sub-station with the new pumping plant, and a 25,000 volt line connecting the pumping plant sub-station with the main hydro-electric sub-station. The approximate cost of the two plants and the high and low tension lines was $44,600.

Regina, Sask.

The operation returns of the Regina Municipal Railway System for the week ending October 3rd were as follows. Revenue, $3,293.95; passengers carried, 77,507; the corresponding figures for the week ending October 10th were $3,471.30 and 80,829, and for the week ending October 17th, $2,880.05 and 76,213.

A temporary amalgamation of the outside and inside electrical workers has been brought about. The amalgamation will be effective during the winter months and is the result of the scarcity of work during these months. The new union will consist of between 70 and 80 members.

Shannon, Que.

The Springfield & Wickham Rural Telephone Company, Limited, has been incorporated with head office in Shannon, Queen's County, N.B.

St. Catharines, Ont.

The cause of a recent fatality in St. Catharines, whereby Mr. A. J. Leach lost his life by touching an electric wire in his home, is said to have been due to lack of inspection and improper electric wiring. Apparently it is a repetition of the old trouble resulting so often where transformers are either improperly grounded or not grounded at all.

The Lincoln Electric Light and Power Company have asked that the St. Catharines Hydro-electric Commission be restrained from interfering with the company's poles and lines.

St. John, N.B.

The Canada Nail and Wire Company have commenced a plant here for the manufacture of horse shoe nails. They are installing a lighting system using multiple C. G. E. magnetite arc lamps and, when completed, will have one of the best lighted plants in Canada.

The Atlantic Sugar Refinery put their electrical plant in service last month. It consists of two 300 kw., 250 volt, 3 wire, direct-current generators and one 200 kw., all direct connected to McIntosh & Seymour Corliss horizontal engines. The electrical equipment was installed by the Canadian General Electric Company.

Stratford, Ont.

The local Light and Heat Commission have voted $3,500 to the Canadian Patriotic Fund, and $200 to the Belgian Relief Fund.

The Light & Heat Commission have decided to provide light free of charge to the families of the soldiers, whether reservists or volunteers, who have gone to the war.

St. Thomas, Ont.

Between January 1st and September 30th of the present year, 330 new electric customers have been connected up, bringing the present total to 1,715.

Toronto, Ont.

The public school yards are being illuminated with four large nitrogen tungstens each.

Contracts have been awarded for the supply of school telephones in Earlscourt, Dufferin and Clinton Schools to Mr. Geo. J. Beattie, 72 Victoria Street, and in Hester How School to Lintz Porter Company.

Work is progressing on the Queen Street East extension of the Toronto Railway System, which will soon reach to the city limits. The famous stub line is being torn out and replaced by approximately a mile of double track, reaching from McLean to Blantyre Avenue at the city limits.

The Board of Control recently passed a resolution instructing Corporation Counsel Geary to apply to the Dominion Railway Board for an order compelling all railways entering the city to electrify their system to a point not less than two miles beyond the city limits.

Mayor Hocken is reported to have stated that he expects the new reduced rates will go into effect in Toronto about New Year's time.

The Canadian Laco-Phillips Company, Limited, has been licensed to carry on business within the province of British Columbia.

The city's request to the Ontario Railway Board to force the Toronto Railway Company to place 150 extra cars in service, was met by the company with statistics showing that the receipts were considerably less at the present time than at the corresponding period a year ago, and that, on account of the financial conditions, it is extremely difficult to obtain ready money with which to make extensions. The board appeared to consider the objections of the company as reasonable.

On October 19th thirteen towns and townships voted on the question of guaranteeing bonds sufficient to cover their share of expenditure on the hydro radial scheme which the Ontario Hydro-electric Power Commission of Ontario has outlined for the district north of Toronto. In eleven out of the thirteen districts, the vote was favorable to the construction of the radial lines. Newmarket town defeated the by-law by a vote of 337-275, and Uxbridge township also gave an adverse vote of 176-141. The towns of Whitby, Uxbridge, Markham, Stouffville and Port Perry all gave good majorities, the latter vote being 153 for to two against. In the six townships of Pickering, Whitchurch, Markham, Scarboro, Reach and Whitby, the majorities were also sufficiently decisive to justify the commission in proceeding with the work. As the two points where the adverse vote was recorded are at the extreme end of the proposed line, it is not likely that the general scheme will be weakened in any way. It now rests with the towns and municipalities to say whether the commission shall go ahead with the work. The vote of course was taken subject to the Dominion Government granting a mileage subsidy, and it is unlikely that any definite steps will be taken in construction work before the Dominion Government gives a further assurance of this subsidy.

The Ontario Railway and Municipal Board have handed down a decision that the Toronto Suburban Railway Com-

pany must build a single track on Annette Street from Keele to James Streets.

The Toronto Railway Company objected before the Ontario Railway and Municipal Board to the cross-town line recommended by the Board's engineer. The company backed their objection by the personal evidence of the manager of the Cleveland Electric Railway System, who stated that such a line did not prove a success in Cleveland and that the old system has been resorted to.

Additions are at present under way to the electric pumping system in Toronto, which will bring the total up to approximately 175,000,000 gallons per day.

Uxbridge, Ont.

At a mass meeting in the town of Uxbridge on the evening of Thursday, October 22nd, it was urged that the municipal councils of Uxbridge Township and of Newmarket town, re-submit their Hydro-Railway by-law. Failing this, it was stated that Uxbridge would apply to the Hydro-electric Power Commission of Ontario for connection with the eastern section of the radial by way of Brooklin, in which case only about three miles of the road would pass through Uxbridge township.

Walkerton, Ont.

The Bruce Municipal Telephone system will be extended, the necessary permission having been obtained from the Ontario Railway and Municipal Board.

Welland, Ont.

The Welland Sign Company have just finished the erection of an attractive electric sign for the McMurray Electric Company.

Wallaceburg, Ont.

The town council have decided to equip a number of streets with a proper lighting system.

It is stated that the Wallaceburg Gas Company have raised their rates to commercial customers to 12 cents per kw.h. and the rate to householders to 11 cents. The day service is also to be discontinued.

Walkerville, Ont.

The electors recently carried a by-law authorizing the purchase of the street lighting system for $26,000, and the council has decided to extend the distribution lines along a number of streets not at present supplied.

Westville, N.B.

The intercolonial Coal Mining Company are installing an electrical pumping equipment in their Westville slope. The outfit consists of one 3 phase, 60 cycle, 300 kv.a., 450 r.p.m., 2200 volt generator, direct connected to a vertical engine with direct connected exciter; also one 175 h.p., 550 volt motor driving a high head pump. The electrical equipment is being furnished by the Canadian General Electirc Company and the engine is being supplied by the Belliss-Morcom Company.

Williamsburg, Ont.

A by-law authorizing the expenditure of some $3,000 on an electric distributing system was carried without a dissenting vote.

Wolfville, N.S.

The Acadia Electric Light Company are installing a small auxiliary equipment to take care of light loads. It consists of one 2-cylinder, 2-cycle, vertical, semi-Diesel, oil engine, 50 h.p., of Swedish manufacture, along with one A. T. B., 60-cycle, 37½ kv.a., 2,200 volt, 1,200 r.p.m. generator with exciter and panel. This town has only had a 1 a.m. service, but will now enjoy an all-night service.

Woodbrigde, Ont.

Hydro-electric power was turned on at this point on Monday, October 12th. The Toronto Suburban Railway Company also commenced the operation of their cars into Woodbridge at that date, the celebration also of the widely renowned Woodbridge Fall Fair.

"Leather Leggin's"

By Berton Braley

"Whin you want to build a railroad through the jungle or the veldt
Where there's niver annyboddy bin before,
Why, you call on Leather Leggin's an' he hitches up his belt
An' takes it as his ordinary chore
To go slashin' through the forests where the monkeys chatter shrill
An' the lazy snakes are hissin' down below,
Or to drag a chain an' transit over gulch an' grassy hill,
As he marks the route the right av way will go!

"He's a nervy, wiry divil with his notebook an' his livil,
An' he doesn't seem to know the name av fear;
He's a sort av scout av progress, on the pay roll as a Civil—
Though he ain't so awful civil, if you say it on the livil—
On the pay roll as a Civil Ingineer!

"Whin you need to dam a river or to turn it upside down,
Or to tunnel underneath it in the mud,
Or to bore an' blast a subway through the innards av a town,
Or to blow aside a mountain with a thud;
Whin you want to bridge a canon where there ain't no place to cling
An' the cliffs is steep an' smoother than a wall,
Why, you call on Leather Leggin's and he does that little thing,
An' then comes round an' he asks you, "Is that all?"

"Oh, he always has a fire in his old an' blackened brier
An' he tackles anny job that may appear,
An' he does it on the livil, this here divil of a Civil—
Though he ain't so very civil, if you put it on the livil—
This here divil av a Civil Ingineer!

"Now the bankers down in Wall Street gits the profits whin it's done
While us heavy-futted diggers gits the can,
But we lifts our hats respectful to the ingineer, my son,
For that feller, Leather Leggin's, is a man!
Yes, he takes a heap av chances an' he works like Billy Hell,
An' his job is neither peaceable nor tame,
But you bet he knows his business an' he does it mighty well
An' I want to give him credit for the same!

"He is plucky—on the livil—and you'll niver hear him snivel
Though fate does her best to put him in the clear.
He's the grit that niver flinches—on the pay roll as a Civil—
For he's sometimes pretty civil an' he's always on the livil—
On the pay roll as a Civil Ingineer!"

Electrical News
Generation Transmission and Application of Electricity

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What is Being Done?

Following our discussion, in the November 1st issue of the Electrical News, of the fatality in St. Catharines, we have been advised by the Hydro-electric Power Commission of Ontario that everything possible in the way of moral suasion has been and is being done to have the various distributing systems throughout the province properly protected by grounding. Whether anything more than this is being done we have not learned, but if not it would appear that the seriousness of recent developments would justify active and aggressive measures to reach the desired end. It may be true enough that, legally speaking, failure to punish neglect on the part of a private company to comply with a law does not relieve that company of the consequences, but still, in the mind of the average layman, that company has a pretty good excuse. Such an excuse would carry ten-fold more weight too, if it should happen to be shown that the Ontario Commission, the administrator of its own law, were itself breaking the law in operating one or another of its own systems still ungrounded.

This matter has surely been hanging fire long enough, and enough lives have been sacrificed in both private and municipal plants throughout Ontario, to justify enforcement of the most stringent orders. If the Hydro-electric Power Commission of Ontario does not take the matter up, then the act should be administered direct by the government—and with an iron hand—whether municipality or private company is concerned. It is not a matter at all of private company opposition. Both private companies and municipalities are offending and as a matter of fact the private companies are eager enough to carry out any improvement which will relieve them of such heavy liabilities as they are often called upon to assume through such accidents as the one in question. Quite aside from that too, private companies are composed, in certain cases at least, of very human beings, who show quite as much respect for the lives of their employees as the municipalities do. Why then the delay? Why not do something, at once, to guarantee our citizens against such unnecessary and heart-rending tragedies as we have witnessed so often in the last five years?

Ready for the Next Step

The Canadian Government has taken a stand that is unanimously approved in Canada, in prohibiting the export of nickel to any point in the world where it can by any reasonably conceivable means finds it way into the enemy's possession. Eternal vigilance in ensuring that this prohibition is carried out to the letter is the next essential, in which case we are wielding one of the most powerful weapons that can possibly be brought to bear against the enemy, and one which must have a very prominent part in determining the outcome and the duration of the present struggle.

So much for the present situation—but what about the future? Canada controls, according to present knowledge, the richest nickel mines in the world. We also have in almost unlimited measure, resources of both coal and iron. Canada thus posseses all, and controls one, of the three essential elements in the production of highest quality steel—a product which, it is probably safe to say, is more universally essential throughout the entire civilized world of commerce today than any other single item.

Should not our government be taking steps, therefore, to ensure the utilization of this valuable mineral within our own borders? The export of nickel at the present, or at any future date, except in its final and most valuable form, should be made as difficult as possible. To this end refining plants should be established either by encouraging private capital to enter the field, or under government management, and every possible encouragement should be given to our iron and steel industries already established and to others that may be induced to enter this field in the future.

The time to foster these industries is not when the war is over and our commercial competitors are again in a position to concentrate their activities on rebuilding their shattered trade—but **now**. Every day the matter is delayed is a day lost, an advantage gained by the enemy. "In times of war prepare for peace" should be the slogan of industrial Canada from the present moment. Let us so govern ourselves that, when the inevitable day of trade revival shall have dawned, our competitors will find we are already well prepared and have made a good start towards the goal of industrial supremacy.

Buy Electric Christmas Gifts

We ask the special attention of electrical jobbers, dealers and central station managers to our article in the Dealer and Contractor section, treating of electrical appliances suitable for Christmas gifts. We do not lay claim to any particular originality in thus bringing this matter to your attention, but we do feel that the electrical Christmas trade has been carried on in years past less vigorously than it ought to have been in some cases, and entirely ignored in others. There is no doubt of its profitableness both at the time of the sale and afterwards. Neither is there any doubt that in urging the purchase of electrical goods we are offering excellent value for money received. It seems almost as if some dealers and central station men themselves were not yet convinced of the wonderful value of electrical equipments. If there are a few such isolated cases, we can only hope that they will, in the near future, make a few tests

in their own homes. Up to the time of going to press with this issue, we have never heard of a single case of an electrical device being discarded which had once been given a fair chance of establishing its value and place in any household.

Electrical equipment in the home has, of course, been greatly boosted during the last year or two, but the remarkable fact about the whole matter is that all the statements are justified by results, and have even proven to be underestimates. As electrical men, then, let us continue to boost electrical household equipment, if not for what it is actually worth, at least for as nearly what it is worth as a limited vocabulary will allow us.

No Change of Program

The Committee of Management of the International Engineering Congress have issued a pamphlet denying the report recently circulated to the effect that this congress was to be abandoned. The congress will be held in San Francisco, as scheduled, from September 20th to 25th, 1915.

In view of the conditions now prevailing in Europe, the governing bodies of the five National Societies under whose auspices the Congress is to be held, have recently given careful consideration to the feasibility of holding the Congress and to the probability of its success, with the result that each body has unanimously confirmed its original pledge to support the Congress. The Committee of Management is actively proceeding with arrangements, which are now well advanced, for meetings on the scheduled dates and for the publication of the transactions.

The Committee of Management is in receipt of a sufficient number of communications from various foreign countries throughout the world, including those located within the war zone, to indicate that a large majority of the papers originally requested for presentation at the sessions of the Congress and publication in its transactions will be handed in on time, and that the Congress will be truly international in character.

A detailed circular of information regarding the publications of the Congress has been prepared by the Committee and will be sent upon application to the Secretary, in the Foxcroft Building, San Francisco, California.

Adding to Their Library

The Toronto Branch of the Canadian Society of Civil Engineers since last January have added to their library a considerable number of valuable series of Transactions, Proceedings, Journals and Reports, and, as well, some eighty engineering treatises and text-books. It is the intention of the Library Committee to have a printed catalogue of the whole library prepared and distributed in the near future, but, in order to encourage the immediate use of the library, this bulletin is issued. For the sake of brevity, only the more important series of publications are mentioned specifically.

Those desiring to consult the library will find at the headquarters of the Branch, 90-96 King Street west, a complete card catalogue according to authors and subjects covering not only the books, periodicals and reports belonging to the branch, but the libraries of the Engineers' Club, Ontario Association of Architects and Association of Ontario Land Surveyors. To all of these libraries members of the branch have access.

The eighty books added to the library comprise the most recent works on bridge engineering, cement and concrete, ceramics, chemical engineering, electrical engineering, foundations, heating and ventilating, highway engineering, hydraulics, mechanical engineering, metallurgy, railway engineering, sanitary engineering, steam engineering, structural engineering and water supply.

The usefulness of the periodic literature in the Library has been considerably increased by the addition of the Engineering Index from 1906 to 1913.

The thanks of the Society are due the following firms and individuals for gifts of books and publications:

To the American Water Works Association for its Proceedings for 1902-1913.

To the Canadian Westinghouse Company (per Mr. W. M. Andrew) for a bound set of the Electric Journal.

To the Electrical News for 36 volumes on Electrical Engineering subjects.

To the Institution of Electrical Engineers (per Mr. Lawford Grant) for a set of its Journals for 1904-1914.

To the Boving Company of Canada and to Messrs. Edmund Burke, W. F. Ferrier, Arthur Hewitt, A. B. Lambe, A. L. Mudge, C. H. Mtchell, H. G. Nicholls, G. G. Powell and Norman Rankin for miscellaneous books, journals and reports.

In order to further extend the usefulness of the Library, it has been decided to allow members of the Canadian Society of Civil Engineers, in any grade, to borrow single volumes for a period not exceeding seven days. A fine of two cents a day will be levied upon any one who fails to return a borrowed volume upon the due date, and the Committee reserves the right to withdraw borrower's privileges from any member failing to comply with the regulations of the Library.

Those wishing to avail themselves of the privileges offered will consult the Librarian, Mr. R. B. Wolsey, or one of his assistants.

Conservation of Western Water-Powers

The water power branch of the Department of the Interior, Canada, J. B. Challies, superintendent, have ready for distribution a limited number of "Water Resources Paper No. 2," covering Bow River power and storage investigations by M. C. Hendry, B.A.Sc. The importance of this work is well set forth in the superintendent's introduction, which reads in part as follows:—

"Conservation of the waters of the Bow River is of the utmost moment for upon it directly depends the agricultural and industrial prosperity of a very large area of southern Alberta. Rising in the high and remote regions of the Rocky Mountains National Park, and, with its many tributaries, furnishing the most interesting and attractive feature of this world-famed scenic park, it emerges from the park only to be harnessed to supply energy for transmission many miles away to the City of Calgary for municipal purposes, street lighting, tramways, and for general commercial and industrial use. After furnishing this hydro-electric energy, the same waters have, by irrigation, converted thousands of acres of otherwise useless land into the most fertile and fruitful tracts within the Province.

"At 'first blush' it would appear that the two important uses of this water for irrigation, and for power, would result in serious conflict of interest. Fortunately the irrigation requirements occur during high water stages of the river, and storage on its upper waters would make it possible to conserve enough of the flood flow, not required for irrigation, to equalize the low flow during the winter months that may be necessary for power purposes. The present use and distribution, and the future conservation, of the water resources of the Bow River basin, constitute one of the most important problems before the Department of the Interior. In some of its phases this problem has already been solved, while in others it awaits solution, although a beginning has been made, and the lines of practicable progress have been fairly well marked out.

"Realizing the importance of the Bow River waters to

every phase of the development of the district through which it flows, and of the utmost necessity of having a practicable conservation scheme worked out and put into practice without delay, the Dominion Water Power Branch has made a thorough investigation of the water resources of the Bow River basin above Calgary. These investigations have been carried on to completion with all reasonable thoroughness and every possible despatch under the immediate direction of Mr. M. C. Hendry, B.A.Sc., who has acted throughout with the continuous advice and assistance of Mr. C. H. Mitchell of the Consulting Engineering firm of C. H. and P. H. Mitchell, Toronto. They have been surprisingly gratifying, showing that it is economically feasible to so regulate the flow of the Bow River, by means of storage works in its upper waters, as to warrant the development at six power sites of over 45,000 continuous 24-hour w.h.p., all within 50 miles of the City of Calgary. At the same time it has been shown, that the using of these waters for power purposes above Calgary need not conflict with the consumption of the same water below Calgary for irrigation purposes; rather would the regulation proposed for power purposes be a distinct advantage to the extension of existing irrigation systems to their ultimate capacity, and also insure in the future the instigation of additional irrigation projects."

Edmonton Power Plans

Some weeks ago the City Council of Edmonton, Alta., intimated that they were open to receive offers for the supply of electric power in bulk quantities for a number of years. It was further decided that all offers received were to be referred to Mr. Willis Chipman, of the firm of Chipman and Power, Toronto. The date set for receiving these power propositions was September 1st. Five offers have been received as follows:—

Sanderson and Porter, of New York and San Francisco, who propose to develop power on the Moose River in British Columbia, 250 miles west of Edmonton on the G. T. P.

G. W. Farrell and Company, of Montreal, who propose three plants on the Saskatchewan river, the first one at Rocky Rapids, 60 miles west of Edmonton.

The Wabamun Coal and Power Company, who propose to generate power from coal at their mine, 40 miles west of Edmonton.

S. W. Candy, capitalist, of Edmonton, offers to form a company and take over the present power plant and sell power to the city at a greatly reduced rate as compared with what it is costing the city to produce power now.

H. W. Adcock, of Winnipeg, who controls the water rights at Grand Rapids on the Athabasca, asked for an extension of time in which to submit his proposal.

Hamilton Branch Elects Officers

The annual meeting of the Hamilton Electric Light & Power Company Section of the C. E. A. was held at their meeting room, Terminal Station, on Thursday evening, October 15th. The following officers were elected:—Hon.-president, W. C. Hawkins; Hon. vice-president, E. P. Coleman; President, W. A. Sweet; Vice-president, Charles H. Fry; Secretary-treasurer, Leo V. Blatz. Executive committee,—Mr. Walter Kelly, W. E. Goring, Geo. D. Fearman, J. C. Smith. Property man, Chas. H. Fry.

Mr. Dorland, the retiring president, commented briefly on what had been accomplished during the past season. Mr. G. H. Goring, retiring secretary, also gave a complete report on the general affairs of the Section. A hearty vote of thanks was tendered to the retiring officers, as follows:—President, W. D. Dorland; Vice-President, Mr. Geo. D. Fearman; Secretary-Treasurer, Geo. H. Goring; Executive, L. W. Pratt, Chas. H. Fry, Hugh Lennox and W. G. Angus.

Financial Standing for Nine Months

A statement has just been given out by Sir Adam Beck with reference to the financial standing of the muncipalities, served through the Hydro-electric Power Commission of Ontario with Niagara power, covering the first nine months of the year. Certain of the municipalities, owing to adjustments yet to be made, are not reported, but from the figures given there is a surplus shown in every case. The figures follow:

Municipality	Gross Surplus	Net Surplus
Ottawa	$28,144.05	$ 1,673.65
Hamilton	28,213.73	12,213.73
London	48,289.16	27,067.16
Berlin	15,391.24	6,519.24
St. Thomas	19,344.64	14,025.64
Guelph	19,174.18	11,469.18
Stratford	9,813.58	5,739.58
Galt	15,325.64	8,380.64
Woodstock	8,891.41	4,877.41
Collingwood	4,009.12	2,026.12
Barrie	4,442.94	2,095.94
Ingersoll	5,797.41	3,210.00
Waterloo	5,366.58	2,750.58
Dundas	3,928.77	2,028.77
Preston	4,631.94	2,181.94
Penetang	1,632.04	183.04
St. Marys	4,369.64	1,919.64
Brampton	4,097.69	1,847.69
Tillsonburg	2,408.07	1,026.07
Weston	2,845.92	1,795.92
Milton	5,332.78	4,582.78
Mitchell	1,954.17	1,054.17
Elmira (10 months)	1,070.60	507.60
Norwich	1,214.05	800.80
Georgetown	1,923.24	1,332.24
N. Hamburg	2,564.15	1,889.15
Acton	546.90	181.99
Stayner	175.27	87.23
Hagersville	591.59	277.59
Baden	1,128.00	913.00
Caledonia	427.03	202.03
Coldwater	801.02	501.02
Pt. Stanley	2,122.04	1,645.24
Elmvale	457.83	202.83
Waterdown	689.33	384.83
Rockwood	821.34	611.34
Beachville	1,877.90	1,577.90
Port Credit	1,123.33	728.53
Thamesford	414.95	295.95

The Westbury Electric Light & Power Company, Cookshire, Que., have completed their transmission line to Robinson Bury, a distance of ten miles, and have had the lights at this point in operation since September 21st. The streets of the two villages known as Upper and Lower Town are now well lighted and about 700 domestic lights have also been installed. The meter rate is 8c. per kw.h., with an exclusive franchise for a ten-year term. Mr. H. A. Worby is president and general manager of the Westbury plant.

"Your directors have the same implicit faith in the future growth and prosperity of the country that they had from the beginning."—Sir Thomas Shaughnessy, president Canadian Pacific Railway Company, in his address to the shareholders at their annual meeting.

Lump Sum Contracts for Power

By H. E. M. Kensit, Mem. A. I. E. E.

Comparatively little attention appears to have been so far given by power companies to the subject of lump sum contracts for power, that is, supplying all the power a customer requires under defined conditions for a fixed sum per annum.

Yet there are in certain cases considerable possibilities and advantages for the power company in this form of contract, and but little risk if the conditions are first properly investigated and the contract drawn with suitable safeguards.

The following remarks, founded on actual cases in which the writer has been interested, are offered as suggestive to power station managers who have not hitherto given any special consideration to this particular form of contract.

It is a fact only too well known to all electrical men that nearly all users of mechanical power over-estimate the power they produce and under-estimate the cost of producing it.

Still, for the sake of developing the argument which follows, it is necessary to go over some old ground and take a simple illustration of a typical case.

A factory working nine hours a day six days a week is operated by a 200 i.h.p. engine. The owner says the engine was indicated by the engine driver some time ago at full load on the factory and showed over 190 h.p., say 165 B.h.p. on the shafting. He therefore figures 54 hours by 52 weeks by 165 h.p. as equal to 464,000 h.p. hours per annum, which would be equivalent to 346,000 kw.h.

After much pressing he figures his cost of producing power and finds it about as follows:—

Fuel (6 lbs. per i.h.p. hour at $4)	$6,400
Oil, stores, water, etc.	450
Wages	2,000
Repairs and Maintenance	600
	$9,450

or $57.20 per brake horse power year.

No Interest or Depreciation

He declines to consider any addition for interest and depreciation, as, from his point of view, the investment is made and would be lost if he substituted other power, or for management, insurance, etc., as this would be practically the same in any case.

If the proposal is to supply him per kw.h., he figures the cost on the above basis as equivalent to 2.7 cents.

He now expects the power company to offer him power at rates sufficiently below $57.20 per h.p. year or 2.7 cents per kw.h. to make it worth his while to displace the engine and install motors, and he does not seriously consider the matter until the power company does so.

Maybe the power company can and does, but these are not the real facts as to costs and there may be a better way leaving more margin to the power company.

The real facts would be about as follows: By holidays and interruptions for repairs the factory will lose about five per cent. of the above calculated time and the average load will probably prove to be under three-quarters of full load, so that the energy actually used will be only seventy per cent. of 346,000 kw.h. or 242,000 kw.h. per annum. The factory costs are therefore at least 3.9 cents instead of the 2.7 cents the owner calculated.

But by the substitution of electric motors with their higher average efficiency, elimination of shafting and gear, facility for working any part of the plant separately, increase of output from steadier driving at the same rated speed, etc., there will be a further saving of 25 to 50 per cent in the energy used. At 25 per cent. the actual energy used would be reduced to about 181,500 kw.h. per annum and this figure represents approximately the actual amount that the power company would be called upon to supply to do the same amount of work as was done by the steam engine.

The object of the above so far is to show that by the substitution of electric power the consumer will usually make a large saving in the h.p. hours used for a given output. Not realizing this he expects a big reduction in the cost per h.p. year and he generally succeeds in getting both; the transaction is one for mutual advantage and the contention is that the power user usually gets more than his just share. None of the increased profit due to the saving in h.p. hours used goes to the power company, yet this is in many cases so large that the manufacturer could afford to actually pay the power company a higher price than it cost him to produce power himself and yet realize a profit on the transaction.

The question under discussion is whether the power company cannot get a larger share of the profit from the economies introduced and yet have a thoroughly satisfied customer.

As shown above the customer would figure his cost at 2.7 cents per kw.h. and he would probably not consider the inconvenience and expense of changing his arrangements unless power was offered to him at 2 cents or less. This is not a very attractive figure to a power company for an ordinary load overlapping on the peak.

Quote Him Lump Sum

Suppose the power company wished to obtain 3 cents per kw.h. The actual consumption after equipment for electric driving would probably be, as shown above, about 181,500 kw.h. per annum, which at 3 cents would amount to $5,445. We will suppose, for the sake of the argument, that this amount was quoted to the manufacturer as a fixed sum per annum for power to drive his factory while producing a given output.

Assume that with re-arrangement and sub-division of driving the customer would require 350 h.p. of motors between 10 and 50 h.p. each to replace his 200 h.p. engine. These would cost about $3,900 and, with an additional 25 per cent. for installation, etc., say $4,900, without allowing for value of plant replaced and sold.

As shown above the manufacturer's costs for fuel, stores, wages and repairs were $9,450 per annum. His annual bill for power will now be about $5,450, and, with 10 per cent. on his new investment of $4,900, for attendance, oil and repairs, a total of say $5,950 for power per annum. The difference of $3,500 represents the annual saving secured by an investment of $4,900 and which would therefore pay for itself in less than two years.

This fixed and guaranteed saving would be a strong enough inducement for almost any "prospect," and at the same time the power company is obtaining 50 per cent. more than it otherwise would, i.e., 3 instead of 2 cents.

Any electrical engineer can, of course, adapt the above figures to suit any case he meets, and the margin may often prove to be considerably greater. In a case within the personal knowledge of the writer, the "prospect" declined to consider an offer of 2.25 cents per kw.h., and the company, after investigation, offered a lump sum contract which was accepted. This showed a handsome saving to the power user and after two years he was still well pleased with his bargain, while the result to the power company is only a shade under 5 cents per kw.h. The power company, of course, do not disclose the kw.h. used.

It now remains to consider under what circumstances such a contract is possible. It is obviously not possible in such cases as woodworking or engineering shops, where the opportunities to waste power are unlimited and where there is no relation between power used and output of the factory. It is possible in such cases as grain, cotton and woollen

mills, boot factories and many other manufactures where a relation can be fixed between the output of the factory and the power consumed.

The power company must first satisfy itself by actual tests over a sufficient period as to the amount of power consumed and by examination of the books and records of the factory as to the output of goods during the same period, and it must ascertain the cost of power to the factory under the existing arrangements. The latter would, of course, be ascertained on the ground of figuring whether the power company's rates would offer any saving and before the proposal for a lump sum supply was made. The company is then in a position to name a lump sum price that will offer a sufficiently great inducement to the manufacturer and at the same time leave the company a satisfactory margin of profit.

Such a lump sum price would be for the supply of power to produce a given annual output from the mill, the price to vary pro rata with the output and the output to be certified annually by a statement audited by chartered accountants, or other satisfactory means. The approximate bills would be rendered monthly or quarterly with an annual settlement on the audited statement of output of the mill.

Such a contract, entered into after proper investigation and with a carefully drawn agreement is a reasonable business deal and would offer considerable advantages to both power company and consumer. The consumer would pay more but he would receive the benefit of knowing in advance what his costs would be and what his saving would be, before he incurred expenditure for new equipment.

The Relations of the Contractor to the Several Branches of the Electrical Industry—Address of President John R. Galloway, before the recent Jovian Convention at St. Louis

The subject assigned me is so broad and comprehensive that to do it full justice would require vastly more time and thought than we can bring to its consideration today. Consequently I shall be brief and touch upon such points as I feel will best apply to the subject, leaving my thoughts with you for your consideration, feeling that you will separate the chaff from the wheat, and trusting you may find in them some seed worth sowing from which you may reap a harvest of some result.

In order to consider this proposition intelligently, it is necessary that we be frank with ourselves; let us come out into the open and wave aside every suggestion that is based upon superstition. We are not here to deal with the subject theoretically by promising ourselves impossible results. Let us submit the proposition to the radium of analysis and discover, if possible, the relations of the contractor to the several branches of the electrical industry.

The time was when every man did business for himself, worked by himself, regarded everyone else in the same line of business as undesirable citizens, and thought his splendid isolation was the only way in which to conduct business. Competition was limited and largely confined to "Have you got the goods," rather than "What is your price?" In those days personal equation in business counted for more than now. Under such circumstances, neither the individual industry nor the community progresses very rapidly.

But the wheels of progress roll on, destroying the old methods, crushing out ignorance, and man is often obliged to give way before them, as the old machines are thrown aside for the new. Education, as the pioneer, must step over human graves, over buried ambitions and lost opportunities. The law of progress is infallible, even if in our short-sightedness we call it cruel. The electrical industry though young, is making great progress, which is only the forerunner of undiscovered wonders, that will make the old things of the past seem like toys thrown away, as childhood steps into manliness through growth, strength and perfection, which in itself is weakness.

With this condition of progress comes the manufacturer who creates each in himself a limited line of commodities, too limited for economical distribution to the retailer and consumer. Then comes the jobber, who stocks the various lines from the many manufacturers; the retailer, and the contractor, who draw from such assembled stock. And from necessity all electrical installations require much of the various kinds of electrical materials manufactured. The contractor, therefore, must have knowledge of, and be familiar with, all the various lines of electrical materials. He must be especially fitted and skilled as to how to properly assemble and install all these various lines of electrical material. It is the contractor who is best suited to point out to the manufacturer the necessity for new devices and changes in the old ones for a better and more perfect installation. And by reason of the contractor's special training toward the proper assembling and installing of electrical material, he becomes a creature of creation, because, after he has completed an installation for lighting or power, he has created a consumer of current, a consumer of additional electrical materials. So by reason of his special training and fitness and the touch of his skillful hands he has been of good assistance to the manufacturer, the jobber, and to the power station. So, by the analysis we find that several branches of the electrical development and the increased production of all lines of electrical materials, and the increase in the use and consumption of current, has been largely through the influence and skill of the contractor. This is beyond question a recognized fact, and I have the courage to say that we contractors have long since been important factors in the development of several branches of the electrical industries; we are proud in our belief in holding that position today, and we stand ready to lend our assistance and best efforts to the end, that the development of several branches of the electrical industries must go on. To do this brings us to the point of co-operation, so we organize and assemble, and mutualize our interests by association and co-operation. We concentrate the individual effort in the direction of a general distribution of responsibility to the end of practical benefits.

Practical commercial interchange in the "Electrical Industry" is no longer a theory—it is a fact. The teachings of the Jovian Order are being accepted as a foundation upon which a strong, stable, betterment of everything electrical can be accomplished. Standing as I do before you today, associated with you as I am, I am impressed with the purpose of your organization, with the earnest and honest efforts of the individuals who are units that in their assembling create what I deem to be the greatest association in the history of modern times. I feel the demand made upon us as poor mortals to bring together under the banner of harmonious association the unit of thought, of desire, of purpose, to the end that the consummation of our hopes may at no late day find emblazoned in letters of gold upon the scroll of effort in the service of humanity the one word, "Success."

I want to see the Jovian Order continue to prosper, because its prosperity means more ideal electrical trade conditions. An organization such as the Jovians, has, therefore, many functions and opportunities for good; it represents the various interests of the electrical industry, and it can be successful only so far as it recognizes the equal rights and privileges of every department of the great industry which it represents. So then the manufacturer, the jobber, the retailer, the central stations and the contractor, all of these various interests are conserved, inasmuch as the success of one is dependent upon the success of the other. They are simply spokes in the wheel of progress.

High Tension Transmission Troubles

Valuable Data on Transmission Practices Collected from the Experiences of a Large Number of Companies

The High-tension Transmission Committee of the American Institute of Electrical Engineers some time ago sent out a printed list of questions to some 105 power companies operating at 25,000 volts and over. This data has now been analyzed and tabulated by the data sub-committee, and was presented in report form at the recent annual convention of the institute. Much of the matter was sent in in the form of comment, and as such does not lend itself to tabulation. A number of these comments are reproduced herewith. It is believed that the comparison of experience and practice set forth in these remarks cannot fail to be of much value to the engineering profession and should certainly be of great assistance to those engineers who may have high-tension lines to establish in the near future, and who have not at their disposal the time and opportunity for the extended research necessary in the construction of plants of highest efficiency.

List of Operating Companies

100,000 Volt Group

Mississippi River Power Company (M.R.P.), Keokuk—recently completed.

Great Western Power Company (G.W.P.), California—operating several years.

Yadkin River Power Company (Y.R.P.), North Carolina—recently finished.

Pacific Gas & Electric Company (P.G. & E.), Central California—operating several years.

Chile Exploration Company (C.E.), Chile—not yet operating.

85,000 Volt Group

Mexican Light & Power Company (M.L. & P.), Mexico—operating several years.

Appalachian Power Company (A.P.), West Virginia—operating short time.

Southern Sierras Power Company (S.S.P.), South Carolina—operating some years.

Pennsylvania Water & Power Company (P.W. & P.), Baltimore.

60,000 Volt Group

Washington Water Power Company (W.W.P.), Washington.

Toronto Power Company (T.P.), Toronto.

St. Joaquin Light & Power Corporation (S.J.L. & P.), California.

Niagara, Lockport & Ontario Power Company (N.L. & O.P.), New York.

Portland Railway, Light & Power Company (P.R.L. & P.), Oregon.

Southern California Edison Company (S.C.E.), California.

Chippewa Valley Railway, Light & Power Company (C.V.R.L. & P.), Wisconsin.

Western States Gas & Electric Company (W.S.G. & E.), California—wood pole construction.

Puget Sound Traction, Light & Power Company (P.S.T.L. & P.), Washington.

City of Seattle Lighting Department (S.L.D.).

50,000 to 25,000 Volt Group

Utah Light & Railway Company (U.L. & R.), Utah.

Canadian Niagara Power Company (C.N.P.), Niagara Falls.

Mount Whitney Power & Electric Company (W.P. & E.), California.

Union Traction Company (U.T.), Indiana.

Long Spans

The following notes of interest were returned:

M.R.P.—Longest span with standard tower and conductor 1,425 ft. The maximum span used on this line is 3,200 feet, and occurs at the crossing of the Missouri River. The conductor cable consists of a 5/8-in. high-strength galvanized 19 strand steel core overlaid with 20 strands of No. 10 B. & S. gauge hard drawn copper wire. The cable is filled with a compound for the exclusion of air and moisture. Each circuit is carried on a single tower line, conductors in a horizontal plane, spaced 20 ft. apart, with two ground wires 10 ft. above at point of support. These river crossing towers were especially designed and vary in height from 60 to 230 ft. above foundations.

G.W.P.—One span 2,300 ft. on special towers; one 2,740 ft. with No. 000 B. & S. "Minot" stranded wire; conductor balanced by counterweights to give uniform tension.

M.L. & P.—One 1,400 ft. with a difference in elevation of 350 ft.; cable size and towers standard.

P.W. & P.—Longest span with standard conductors and towers 1,280 ft. Longest span 1,800 ft. with No. 0000 B. & S., 7 strand hard drawn copper and towers 115 ft. high over all above foundations. Span sag 120 ft. (6.7 per cent.). Distance between conductors, vertically 10 ft., horiontally 15 ft.—Ground wires above conductors—no trouble.

S.L.D.—Longest span 780 ft. standard double-pole construction.

W.W.P.—One 1,500 ft., 1/4-in. "Siemens-Martin" steel as conductor.

S.J.L. & P.—Span across Kings River at Piedra, six 3/0 aluminum cables, carried about 1,700 ft. across river and anchored on hillsides to cedar poles. Two sets of three wires each are attached to two poles, wires in a vertical plane six ft. apart and attached to poles with two Locke No. 273 strain insulators. Guys are placed for each wire and run to anchorage in rocks. About 200 ft. sag is obtained with wires clearing river about 150 ft. All wires swing in unison in a high wind and no trouble has been experienced.

C. N. P.—The transmission line crosses the Niagara River at Buffalo where there is a span of 2,192 ft., from a 150-ft. tower on the American side to a 202-ft. tower on the Canadian shore. The tops of these towers are at the same elevation. The line is then carried over the village of Fort Erie with a span of 1,667 ft. to a 61-ft. tower on Bertie Hill. The top of this tower is 107 ft. below that of the High tower. The minimum clearance of the cables above the river is 130 ft. On the high towers the cables are arranged on 15-ft. triangles and on the Bertie Hill tower on 10-ft. triangles. The twelve conductor-cables are made up of 19 strands of No. 10 B. & S. gauge bi-metallic wire and are stressed up to 5,400 lbs. This tension is kept constant by counterweights on the Buffalo and Bertie Hill towers. The counterweights are supported by steel cables which run over sheaves at the top of the towers and are connected to each bi-metallic cable through two pairs of spool insulators. Drop cables pass down and through the tower to the Buffalo terminal station and on the Bertie Hill tower to the bus-bars. The bus-bars and switches are so arranged that any circuit on the pole lines can be connected to any circuit on the long spans. At the

high tower, the cables are connected to galvanized iron chains which rest on insulated saddles and extend about 13 ft. on each side of the tower. Jumper cables are carried over the saddles.

In addition, spans of 800 and 1435 ft. were reported by other companies and no cases of trouble.

Special Features of Construction

The following notes relate to special features of interest in construction:

A. P.—All suspension insulators are ballasted with 30-lb. cast iron weights.

P. R. L. & P.—Experience has shown that it is cheaper and quicker to erect steel towers in position from the ground up.

Anchor Towers on Tangents

The following reports were made on the use of anchor towers on tangents:

M. P.—Approximately every mile.

G. W. P.—Average every two miles; designed to stand with all wires cut.

A. P.—Two per mile, designed to stand with all wires cut.

S. S. P.—Every five miles, designed for 24,000 lbs.

P. W. P.—At least every fifth tower; on average five to mile.

S. J. L. & P.—Poles guyed both ways every half mile; will stand with three conductors cut.

N. L. & O. P.—Every mile on steel towers; every half mile on "A" frames; all to stand with all three conductors cut.

S. C. E.—No, use line guys.

U. L. & P.—Every 1½ to 3 miles, according to wind conditions; designed to stand 7,000 lbs. at centre crossarm in addition to stress on regular line towers.

C. N. P.—Only at two ends of line and two intermediate curves; designed to stand all conductors cut.

Deterioration

The following notes on deterioration were received:

G. W. P.—Slight rusting where towers were not properly galvanized; wires corrode.

Y. R. P.—Line two years old; no deterioration noticed.

P. W. & P.—No deterioration observed upon examination of buried portions of galvanized towers. One particular set of gusset plates near top of tower showing signs of rust during 1913; no rust or deterioration elsewhere. No signs of deterioration in conductors. Insulators both on transmission line and in stores showing deterioration, due possibly to temperature expansion effects. About 4 per cent. of insulators examined to show such deterioration; not due to electrical causes.

W. W. P.—We have noted no deterioration in conductors. Some insulators placed in service in 1904-1906 indicate that they may have deteriorated, but as the manufacture of porcelain at that time was far less efficient than now, no results of long time tests on those would indicate what will obtain on the ones of later manufacture. Towers were placed in 1910, and no deterioration has been noticed.

T. P.—Except for some deterioration of ground wire and hemp core of conductor, no deterioration noticed.

S. J. L. & P.—No deterioration noticed as yet; 60,000-volt system in use only three years.

N. L. & O. P.—Galvanized towers develop rust spots in about seven years. Insulators to some extent deteriorate by puncture of an occasional skirt. No noticeable deterioration of cable except by occasional burning by arcs.

P. R. L. & P.—The transmission line has been in service less than two years and we have, therefore, no observations of deterioration except in the matter of insulators, there having been a considerable number of failures in suspension insulators and insulators in a strain position since the line was put in service.

S. C. E.—Insulator shells crack, presumably due to expansion of cement or steel pin.

C. V. R. L. & P.—Insulators give more trouble with age.

U. L. & R.—Wood poles with carbonized butts last 10 years in this climate.

P. S. T. L. & P.—None, if proper factors of safety were observed in original installations. Steel towers have to be painted every two years, if not galvanized. Cedar poles rot off at the ground in from 15 to 20 years.

S. L. Dpt.—Poles rot at ground line.

Deflection of Suspension Insulators

As to how much angular deflection of conductor was assumed under wind conditions and how much was actually observed, the following data were reported:

M. P.—26 deg. 45 min., with ½-in. ice, assumed.

G. W. P.—45 deg. assumed.

Y. R. P.—45 deg. assumed.

A. P.—30 deg. on swinging of strings; held down by 50-lb. weights.

S. S. P.—45 deg. assumed; 45 deg. observed on swings.

P. W. & P.—Approximately 60 deg.; probably never more than 30 deg. angular deflection from vertical due to wind observed under either steady wind conditions or swings. No good records on actual angular deflection. Conductors do not swing violently, and angular deflection is not the same at all points in a span for one conductor, but is the same for all conductors.

W. W. P.—50 deg. assumed; 36 deg. observed.

U. L. & P.—60 deg. from vertical assumed, this value observed in swings.

Design Factors of Safety

As to the factors of safety provided in conductors, towers, against overturning foundations, and overhead ground wires, the following data were reported:

M. P.—Conductors 2, towers 3, foundations 2, ground wires 2.

G. W. P.—Conductors 2, towers 2, foundations 3, ground wires 3.

Y. R. P.—Conductors 25,000 lbs. per sq. in.

M. L. & P.—Conductors 2 and 3, foundations 1.5.

A. P.—Conductors 2, 3, towers 2, foundations 5, ground wires 10.

S. S. P.—Conductors 2.5, towers 1.7, foundations 1.7.

P. W. P.—For conductors (alum.) up to elastic limit; towers tested for maximum designed strength at factory; foundations practically 4; ground wire just up to elastic limit.

W. W. P.—For conductors elastic limit, for towers 1, for foundations 1, for ground wire 1. These factors are taken in view of the fact that the maximum load conditions assumed were very severe.

S. J. L & P.—For conductors 6, for poles 3.

N. L. & O. P.—For conductors 1 (elastic limit), towers 2, foundations 2.

S. C. E.—For conductors 22,000 lbs. per sq. in. working stress.

S. L. D.—Factor for conductors of 3 over elastic limit.

Overhead Ground Wires as Part of Structure

In answer to the question as to whether overhead ground wires are relied upon as part of the line structure most of the companies replied no, but the following comments were received.

Y. R. P.—Yes.

P. W. P.—Ground wire gives some stiffness lengthwise of line, damping longitudinal vibrations of towers, but is not relied on as part of the mechanical supporting structure.

U. L. & P.—No, but it undoubtedly acts as a guy wire.

Cutting Out of Load

A loaded circuit is usually cut off by an oil switch, sometimes on high tension, sometimes on low tension. The following replies are noted:

G. W. P.—Drop generator load and open generator oil switch on low-tension side. Do not switch on high-tension side.

Y. R. P.—(a) Reduce voltage 60 per cent. and then open low-tension oil switch. (b) Open low-tension oil switch at full voltage. (c) Open high-tension oil switch at full voltage.

M. L. & P.—Cut out sections of line one at a time loaded or unloaded. Experience shows that this method gives less trouble from surges on oil switches and switch bushings.

Opening Short Circuit

To open a short circuit that holds on, the following companies reduce the voltage of the generators:

M. P.; G. W. P.; S. C. E.; C. N. P.

Note also the following comments:

S. S. P.—The hydro-electric plants are tied in by non-automatic switches on the low-tension side while the steam plant has oil breakers with definite time circuit relays on the low-tension side. The high-tension switches in the main tower line are of the Bowie air-break type and are non-automatic. As operated at present, when short circuit occurs on tower line, the steam plant breakers clear the southern end of the system of trouble, leaving the steam station with all load in that teritory. The hydro-electric plants then drop voltage to low value and test for location of trouble .

S. C. E.—Separate main system into sections and cut out step up transformers on high-tension side.

Automatic Overload Relays

Automatic overload relays are generally used, and in many parts of the various systems. The majority are definite time limit or inverse time limit. The overload settings run from 100 per cent. to 300 per cent. overload, and the definite time limits from ½ to 10 sec. A half dozen companies use overload relays of progressively greater time element distributed from the load to the generator.

M. P.—Use inverse time limit automatic overload breaker to cut apart groups of generators on the 11,000-volt generator busbars.

N. L. & O. P. and S. C. E. report success with this selective action; Y. R. P., M. L. & P., and W. W. P. report partial success.

P. W. & P.—Automatic overload circuit breakers are used in connection with 13,000-volt cable feeders, station auxiliary transformers at both power house and sub-station, and transmission lines; in the last case, however, not the high-tension circuit breakers, but the low-tension circuit breakers of those transformers connected with the line being opened. In connection with 13,000-volt cable feeders, we use inverse-time relays; for the transformers and transmission line, definite-time-relays.

(a) The lowest tripping current for the relays connected with our 13,000-volt cable feeders is 100 per cent. overload, based on cable rating; with 700-1,400 per cent. overload these relays will trip in 1 sec. (inverse time).

(b) The relays for the sub-station transformers are reverse-power relays set to trip at 50 per cent. overload in reverse direction, and connected with a three-sec. definite element.

(c) The power house transformer relays trip at 140 per cent. overload 7 sec. definite time.

Time-element relays are normally used with progressive timing of the elements. This refers particularly to the relay system used for the 13,000-volt a.c. underground cable system in Baltimore, of which a part belongs to the P. W. & P. Co., and a part to our customers' distributing systems. The larger part of the relays for this system are Type C Westinghouse overload inverse-time relays improved by F. E. Rickett's compensating coil, which produces a relay curve with less steep characteristic and for heavy overloads can be brought to approach a definite time. Both tests and experience have shown that this type of relay can give good selective action for several relays in series. Bellows type relays were previously used in this connection but were found to be not sufficiently reliable and were replaced by relays of the type referred to above. Westinghouse Type C, improved, reverse-power relays with selective element are also used. These reverse-power relays are used at the sub-station end of two transmission lines working in parallel. When a short circuit, which is not cleared in any other way, occurs on one line, it will trip the low-tension side of transformers at the substation connected with this line, while overload or time relays will trip the low-tension side of the correspondng transformers at the power house. If the other transmission line is not affected, the reverse-power relays for this line will remain open. In order to give another device (arc extinguishers) time to relieve lightning arcs, these relays for the transmission lines are furnished with definite time-limit relays (W. Type E); these have at present the following setting:

	Circ. No. 1	Circ. No. 2
Power House	3 sec.	2½ sec.
Substation	1½ sec.	1 sec.

The different time setting for the two circuits is chosen in order to prevent one line from opening at the sub-station, while the other opened at the power house, in case both lines should be in trouble. As soon as one circuit is cleared, an interlocking device prevents the other from opening by any relay action. If after the clearing of one of the two paralleled transmission lines, the other still shows the trouble the field will momentarily be taken off all the generators at the power house simultaneously, and restored again. Should this action not clear the second line, the switches must be opened by hand. Our experience so far shows, however, that permanent line trouble (wires down, etc.) never has taken place on both circuits at the same time.

P. S. T. L. & P.—Success generally but not always.

Aside from the P. W. & P., the U. P. & R. and P. S. T. L. & P. are the only companies using reverse-energy relays; the former reported "always" act selectively—the latter does not state the result.

S. I. D.—Use Westinghouse Type C, reverse-energy relays which act selectively when the power factor does not drop too low as on a very heavy short circuit.

Dropping Synchronous Load

The following report that they seldom or never succeed in carrying synchronous load through a heavy main-line short circuit:

G. W. P.; M. L. & P.; S. S. P.; T. P.; S. J. L. & P.; P. R. L. & P.; W. S. G. & E.; C. N. P.;-U. T.; S. L. D.

Other reports—

A. P.—Sometmes. Lightning arcs are frequently cleared by arc suppressors without losing synchronous load.

P. W. & P.—Lightning arcs are frequently cleared without the least loss of load, by arc suppressors.

W. W. P.—We have automatic switches on all lines feeding out of the different stations and when these act properly we very seldom lose any synchronous load.

N. L. & O. P.—Save synchronous load by automatic arc extinguishers, when arcs only are involved.

U. L. & P.—Yes, when short circuit is cleared in three seconds.

P. S. T. L. & P.—Sometimes we can and sometimes we cannot. If the duration of short circuit is three or four seconds synchronous apparatus always drops out.

Cutting Out One of Two Parallel Lines

In answer to the question as to when two lines parallel

at both ends could be cut out without losing the load the following were received:

M. P.—Two St. Louis lines parallel at both ends and have been separated in a number of cases automatically without losing the load.

M. L. & P.—Four lines are operated in parallel and as a rule one line can be cut out without losing the load.

A. P.—Sometimes.

W. W. P.—Have such lines but cannot cut them out without losing load.

S. J. L. & P.—Lines are tied together at load end by tie-breaker set light; at supply end lines are separated by operator.

N. L. & O. P.—Have tried this but have abandoned the attempt.

P. R. L. & P.—Yes, but cannot be automatically separated.

S. C. E.—All main lines, cannot separate.

C. N. P.—Cannot separate such lines.

U. T.—Cannot separate such lines.

Locating Trouble

Practically all plants sectionalize the line, test with generator voltage and patrol to locate line trouble.

Y. R. P.—Use also a Wheatstone bridge method.

N. L. & O. P.—Use a special loop test described in the Trans. A. I. E. E., June 1907.

C. N. P.—Uses a loop test.

Effect of Heavy Short Circuit

As to the effect of a heavy short circuit near one power station on a large system:

P. W. & P.—When a short circuit occurs near one power house, the effect of this depends entirely on how long a time it lasts.

(1) If it is a lightning arc on the transmission line it will normally be cleared by arc suppressor.

(2) If it is cable trouble on the 13,000-volt distributing system, it will normally be cleared by opening automatically the proper feeder switches. If the trouble hangs on for more than four seconds the fields of the generators will be destroyed and restored automatically at all three power houses simultaneously.

Operation With One Side Grounded

In answer to a question as to whether the lines were ever operated with one side grounded, even for a brief period, the following were received:

P. W. & P.—For a few minutes, no effect; ground was cut off by the time the ground resistance was red hot.

U. L. & R.—All one night on 28,000-volt circuit; no effect except unbalancing of system.

C. N. P.—For about two hours with no effect except a slight unbalancing of current in conductors.

A. P.—For two hours with no effect.

W. W. P.—For several minutes causing whole system to be unbalanced.

G. W. P.—For about ½ hour; one oil switch bushing and one string of insulators punctured.

S. S. P.—No; effect too severe.

T. P.—On several occasions for five to fifteen minutes, on one occasion four hours. On the occasion when the system was operated for four hours the ends of the cable that were down were 1,000 ft. apart, the ground was highly charged and the barbed wire on the right-of-way fence was also highly charged. A man attracted by the display due to this ground walked into the charged area, then tried to climb the barbed wire fence and was killed. A dog approached the barbed wire fence some distance away and after investigation started for remote regions. Claims were made for damages to cattle. These were paid, although it could not be found that any cattle were really injured. In operating on a ground we have no means of knowing whether or not the wires are down, and as it is possible that there may be two grounds miles apart with an open circuit in the conductor between, we consider it a very risky thing to continue such operation and would only do so as a last resort.

S. J. L. & P.—For two and a half hours on 60,000 volts; for one and one-third hours on 30,000 volts. The effect was unbalanced voltage on the particular feeder having a ground; unbalanced load on nearest generating plant, private telephone line out of commission, troubles reported from Sunset and other telephone systems.

N. L. & O. P.—On one occasion when neutral was not grounded, for two hours; effect "violent."

P. S. T. L. & P.—For 10 minutes; severe strains, discharging lightning arresters; telephone wires hot.

Relays in H.-T. Ground Connection

No plant of those reporting except P. W. & P (see below) seems to have any protective relay in the ground connection from the high-tension neutral, except for the fuse of the Nicholson arc suppressor.

Voltage Regulators

The use of Tirrill regulators to control the voltage of generators is almost universal and there appears to be no exception to the satisfaction they give.

Failure of Oil Switches

As to whether oil switches have ever failed to open a circuit, most companies report no trouble, but the following are noteworthy:

M. L. & P.—Very rarely.

S. S. P.—No, but signs of distress are often shown. Most of the trouble from oil switches occurs in the breakdown of bushings from lightning or surges.

T. P.—H-3 oil switches have failed repeatedly when more than four 100,000 kw. generators can feed through them to a short circuit.

N. L. & O. P.—Yes, from repeated operation on short circuit without overhauling.

U. L. & R.—4,000-volt, three-phase oil switch on overload.

S. C. E.—On short circuits; the system has outgrown the size of the switch.

P. S. T. L. & P.—Oil switches which are type H-3 and K-10 have always opened short circuits successfully but sometimes the switches are nearly wrecked.

Working With Adjacent Line Alive

Practically all companies except S. L. D. work on one of two lines on the same poles or towers when the other line is alive.

Which Insulator of Suspension String Fails First

As to which insulator unit in a string of units is most likely to be injured, note the following:

G. W. P.—Insulator next to line, but in general it is hard to tell.

P. W. P.—Flashovers damage first and last units preferably.

W. W. P.—Nearly always the first and last of the string.

P. R. & L.—No difference.

U. L. & R.—End disks.

Relative Reliability of Suspension and Strain Insulator Strings

There is a difference in experience as to whether strain insulators are more likely to fail than vertical strings. P. R. & L.; U. L. & R.; P. W. P.; W. W. P., and Y. R. P. say "no." G. W. P. and S. C. E. say "yes."

Electric Railways

Developments in Electric Traction*

By W. B. Potter

The electrification of railways has naturally been extended in the classes of traffic where the substitution of electric power has afforded advantages not obtainable with power of some other character. Electric motor cars, as compared with the horse or cable car, were immediately recognized as a more efficient method of transportation, and the extraordinary development of the trolley car service was a natural result.

During the early development of electric equipment for transportation purposes the individual car and the electric locomotive received about equal attention. Because of the greater opportunities in urban service the motor car soon became more prominent, and for a number of years the motor car equipment received almost exclusive attention.

Results obtained in trolley car service demonstrated beyond question the success of electric power and did much to establish confidence in the reliability of electrical equipment. For the heavier service of handling trains the use of a motor car as an electric locomotive was but a natural development. The entrance of electric power into the domain of the steam locomotive really began in the early nineties with small trains in passenger service. The Intra Mural Railway at Chicago in 1893, where motor cars were used as electric locomotives, initiated in this country the permanent invasion of the extensive steam service on elevated lines.

The further development of multiple unit control, permitting any number of motor cars in a train to operate in unison, made possible a schedule performance which even the largest of steam locomotives would be incapable of handling, quite apart from the objectionable features incident to the use of steam.

The earlier applications of electric power to regular steam railway service were in most cases for service in tunnels and railway terminals, with the object of eliminating the smoke and gases common to the use of steam locomotives. The Baltimore & Ohio Tunnel which commenced operation in 1895 was the first instance of electrification as applied to heavy traffic, and the first electric locomotives to successfully initiate the struggle for supremacy with steam locomotives under main line requirements.

Only Question—Will it Pay?

The electrification of main line service is no longer an experiment. The heaviest traffic can be successfully handled, and therefore there remains only the question of whether it will pay. As a rule, excepting the expense incident to the initial investment, the cost of operation with electric power will be less than with steam, and often this saving will show a handsome return on the investment. There are many instances, such as tunnels and terminals where other considerations than the financial showing are of paramount importance. Even in such instances there are often local conditions where the value of property will be enhanced, or where territory necessary to steam service can be made available for other purposes and therefore remunerative.

The possibility of handling heavier, or even equal trains at higher speeds is becoming better recognized as a means of increasing the tonnage over a given route, and so provide for an increasing traffic more economically than by the construction of additional lines under steam operation.

Electric locomotives for heavy traffic must be so constructed as to withstand the service shocks and strains which occur in the handling of trains, and to facilitate inspection and maintenance the electrical and other equipment should be conveniently located. Much attention has been given to the development of different general types, and many varieties of electric locomotives differing both in mechanical design and electrical equipment have been built and tested.

Variations in the mechanical construction are influenced largely by different methods of transmitting the power from the electric motor to the driving wheels. The motor car and steam locomotive have both served as models with innumerable variations in which their characteristics have been differently combined and in many cases with indifferent success. Geared or gearless motors mounted on the driving axle, or in special cases a combination of gearing and parallel rods, each with reference to its fitness for the particular purpose, are the most promising methods of drive. Guiding trucks will undoubtedly be used in high speed service and doubtless at slower speeds with very heavy locomotives where the weight distribution on the track may be of importance.

Relative Merits of A.C. and D.C.

The character of electrical equipment, considering the larger power required in main line service is influenced by the problem of electric transmission to the locomotive and the collection of current from the conduction circuit. As the amount of current varies inversely as the voltage, the transmission and collection are therefore made easier at higher potentials. The development of equipment suitable for higher voltages has received much attention, and there are at present a number of important railway electrifications of this character on which alternating or direct current is used. The respective merits of alternating or direct current involve many details of which only a few are of general interest as influencing the trend of commercial development.

The equipment for alternating current, whether three-phase, single-phase or split phase, does not at present appear susceptible of many improvements by which the cost may be reduced, and there is further an uncertain investment for counteracting the influence of the alternating current on telegraph and telephone lines.

Direct current operation at potentials higher than 600 volts is no longer in the experimental class; the most important electrification being the Butte, Anaconda & Pacific, where successful operation at 2400 volts has been fully demonstrated.

A vital question affecting the use of direct current in heavy service is the amount of current which can be successfully collected from the conducting circuit, particularly

*General Electric Review.

from an overhead construction, as with the third rail there is ample margin even at 600 volts.

As a device for collecting current the ordinary trolley wheel has proven successful in handling far heavier equipment than originally contemplated. The roller pantograph, which is in effect an elongated trolley wheel, has proven very successful in service for which the ordinary trolley wheel would not be suitable. The sliding pantographs, of which there are many in service, when fitted with copper faces have a collecting capacity even exceeding that of the roller, and there is no doubt a pantograph equipped with a suitable sliding collector will successfully collect current to the full capacity of the overhead conductor.

An improvement in the overhead cantenary construction, accomplishing the double purpose of securing greater flexibility and an increased conductivity, is obtained by the use of two conductors lying close together in the same plane, with the supporting hangers located alternately so that the mid-span of each conductor is opposite the supporting hanger of the other. Within practical limits 1,000 amperes may easily be collected from a single 0000 conductor and 2000 amperes from two 0000 conductors. With a copper conductor and copper faced sliding collector having grease lubrication, the tests and obtainable records indicate a life of the conducting wire fully comparable with that commonly obtained with a trolley wheel or roller pantograph.

Indications Favor Direct Current

It is a reasonable statement that with a potential not exceeding 3,000 volts, no difficulty will be experienced in collecting from an overhead construction the current required by locomotives in the heaviest passenger or freight service. The choice of a higher direct current voltage is, therefore, a question of economics—whether the saving in copper or further spacing of sub-stations will justify the greater cost of rolling stock equipment at a higher voltage. Careful estimates, comparing 3,000 volts with higher voltages up to 6,000 as applied to main line operation, show practically no advantage in favor of the higher voltage. In the majority of cases in this class of service the investment for locomotives is by far the larger item as affecting the selection of the voltage.

As between the different systems the indications point strongly toward the more general adoption of direct current for main line electrification and heavy railway service generally.

The Electric Railway and the Farmer

By John R. Graham*

The extension of the electric railway into the rural districts has contributed in a greater degree to the advancement of farming in communities remote from markets than any other development of modern times. The electric railway has brought the markets to the farmer's door, making it possible to load his produce on cars without leaving his premises and at the lowest possible expense for handling and haulage. Butter, cream, milk and garden truck can be delivered fresh to the markets each morning within two hours by express service, enabling the farmer to compete successfully with the city gardener. In many cases small sawmills have been built along the line with convenient loading facilities, permitting the farmer to manufacture his lumber and market it where, previous to the coming of the electric railway, this lumber had little value.

Social conditions on the farm have been immensely improved as a result of the electric railway. The farmer's family is no longer isolated from its neighbors and the city, and the problem of how to keep the children on the farm should no longer be a serious one in the communities thus served. Thanks to the electric railway, the farmer can enjoy the advantages of the city, the schools, churches and the theatre, while his wife and daughters can take advantage of the bargain day sales in the city stores. With the electric railway has also come the electric light, and village streets once dark and gloomy after sunset are now brightly illuminated. Manual labor on the farm is being replaced with electrically-operated devices, and this wonderful development will result in bringing more people back to the farm.

The electric railway is a genuine help to the farmer if its work is carried out along broad lines, without legal restrictions against encouraging the progress of the agriculturist. To aid in developing agriculture along its lines the Bangor Railway & Electric Company has established a demonstration farm of 120 acres on the line running from Bangor to Charlestown. This farm is under the supervision of the University of Maine, to demonstrate the possibilities of intensive production of potatoes, corn, oats and other crops. A strict account is being kept of the amounts of each crop raised and the phosphates used, along with the cost of labor and any other expenses associated with raising this produce. It is hoped to produce 400 bushels of potatoes per acre when the farm is in full operation, compared with the usual 200 bushels which represents the average output of the farmers in the State of Maine.

Ten Fold Freight Increases

In order to encourage the raising of potatoes in the Kenduskeag Valley, the Bangor Railway & Electric Company in 1908 reduced the electric freight rates one-half on carload lots of potatoes. In that year sixty-seven carloads were shipped. The business has increased greatly each year, and in 1913 more than 600 carloads were shipped. During the present season it is anticipated that more than 750 carloads will be handled by the line, representing an increase of more than 1100 per cent. in six years, and on a line only 25 miles long, with a population of but 2500 people. The freight and express over this line totals more than 50 per cent. of that handled on all the other electric railways in Maine. What has been done on this line can be duplicated elsewhere. The opportunities are attractive for the farmer in stock-raising, but to do this successfully there must be good fencing. The farms of Maine present a decided and unfavorable contrast to those of Canada in this particular. Stock raising will help to keep the young men on the farm, and besides improving the fertility of the land it will stimulate additional traffic on the electric railways running through such communities. I would like to buy 500 head of yearling Hereford cattle in the West and distribute them to farmers along the lines of the Bangor company, but at present we have no fences good enough to hold them.

Value of Centralized Management

The prosperity of public utilities closely affects the communities served by them. Farmers sometimes do not appreciate any more than other people the benefits of a centralized management of public utilities. These may be brought home to them in a practical and common-sense way, without undue self-praise. In 1902, for example, the various properties centering at Bangor were five or six in number. Their bonds were selling at about 50 per cent. below par and their stocks were at the lowest ebb financially. None of these corporations paid dividends. All have now been consolidated into the Bangor Railway & Electric Company and are in a prosperous condition through economical and financial operation under centralized management. Where the Maine savings banks and investors used to buy out-state securities, they are now gradually absorbing the stock of our public service corporations. One of the trust companies in Bangor has sold securities to the amount of more than $3,000,000 to investors in our locality. There is a good demand for Maine

* Electric Railway Journal.

public utility securities, and there are great possibilities in water-power development, which should be encouraged by low taxes and liberal laws. The different companies in which I am interested in Maine are today using more than 30,000 h.p. hydro-electrically generated, whereas ten years ago there were only 3,000 h.p. of hydro-electric development in these systems. All of this benefits the farmer as well as the city resident in our territory, and through broadened services, possible production of fertilizer by the utilization of atmospheric nitrogen, application of power from the railway and lighting transmission lines to farming machinery, electric cooking and other developments, the outlook for the future is very attractive. As a device for taking up what might be called economic lost motion between the city and the country, the electric railway managed along the lines above outlined has no superior.

Code of Principles—Adopted by the American Railway Association at their Recent Convention

I.—The first obligation of public utilities engaged in transportation is service to the public. The first essential of service is safety. Quality of service must primarily depend upon the money received in fares. For this reason it is necessary that the rate of fare should be sufficient to permit the companies to meet the reasonable demands of patrons and to yield a fair return on a fair capitalization.

II.—Regulated private ownership and operation of electric railways is more conducive to good service and the public welfare than government ownership and operation because the latter are incompatible with administrative initiative, economy and efficiency, and with the proper development of cities through the extension of transportation lines. The interests of the public are fully protected by the authority given to regulatory bodies.

III.—In the interest of the public and good service local transportation should be a monopoly and should be subject to regulation and protection by the state rather than by local authorities.

IV.—Short-term franchises are detrimental to civic welfare and growth because they ultimately check the extension of facilities and discourage good service.

V.—In order to render good service, electric railways must be allowed to earn a fair return on a fair capitalization, and the foundation for this result will be obtained if the issuance and sale of securities representing such fair capitalization shall be legally authorized on such terms as will produce the requisite funds.

VI.—Securities which have been issued in accordance with the law as it has been interpreted in the past should be valid obligations on which an electric railway is entitled to a fair return.

VII.—The relation of adequate wages to efficient operation should always be recognized, but electric railways, being public servants regulated by public authorities, should be protected against excessive demands of labor and strikes.

VIII.—The principle of ownership of securities of local companies by centralized holding companies is economically sound for the reason that the securities of the latter have protection against the varying business conditions of a single locality or company and because money for construction and improvements can thus be more readily obtained.

IX.—In the appraisal of an electric railway for the purpose of determining reasonable rates, all methods of valuation should have due consideration.

X.—Full and frank publicity should be the policy of all transportation companies, to the end that proper information may be available to the investor and the public.

Company Rights Protected

Canadian holders of Mexican securities will be interested in the further assurance of the Carranza government that their seizure of the property of the Mexican Tramways Company was merely with a view to continuing present operations, and until such time as negotiations between the company and the striking employees could be brought to a successful issue. We understand the proceeds of operations are being handed over to the company regularly.

Special Church Service

The Winnipeg Electric Railway Company have inaugurated a special church service. This will mean that twenty extra street cars will be placed at the disposal of church goers at the time when they are most needed.

Electric Railway Donation

Patriotic Day on Welland street cars resulted in a donation of $220 to the Patriotic Fund. The ladies of the town handled the boxes during the day with the result that fares were anywhere from $5 down.

It is suggested that an application be made to the Ontario Railway and Municipal Board for an order compelling the Toronto Railway Company to provide five cent fares to city workmen on night duty. It is difficult to see, however, how the board can make such an order, as the amount of the fare constitutes a part of the company's franchise agreement.

New Books

Fifth Annual Report—Issued by the Commission of Conservation of Canada, covering the operations of the commission for the fiscal year ending March 31st, 1914, and containing a report of the proceedings of the fifth annual meeting held in Ottawa, January 20 and 21, 1914.

Electric Light Fitting—by S. C. Batstone, A.M.I.E.E., Whittaker & Company, London and New York, publishers; price, 5s. net. This is a treatise on wiring for lighting, heating and other domestic uses to which electricity may be applied. Includes also information covering the lay-out of typical small private installations. It has been the writer's chief aim to adhere entirely to the practical side of the matter.

Polyphase Currents—by Alfred Still, M.I.E.E., M.A.I.E.E., etc.; Whittaker & Company, London and New York, publishers. Price 6s. net. Revised edition. A book treating of the theoretical considerations involved in polyphase working in such a manner as to commend itself to practical engineers and students without the mathematical knowledge required for the study of advanced works on this subject. The assumption is made that the reader has a fair knowledge of continuous currents, but is unfamiliar with alternating currents. Three hundred pages, well illustrated.

Principles and Practice of Electrical Engineering—by Alexander Gray, Whit.Sch., B.Sc., assistant professor of electrical engineering, McGill University. McGraw-Hill Book Company, publishers; price, $3.00 net. This work is based on a lecture and laboratory course delivered to the senior civil, mechanical and mining students at McGill University, and is suited for men who desire to obtain a broad idea of the principles and practice of electrical engineering with only a limited amount of time at their disposal. The book gives a self-contained lecture and laboratory course, much of which is suitable for private reading. The illustrations are excellent throughout and especially in the chapter on alternators, where the different phases are distinguished in colors.

Illumination

Illumination of Public Buildings—No Excuse for Poor Lighting—Engineering Information for the Asking

Little by little the value of modern illuminants, supplemented by proper glassware, is coming to be appreciated, both in private and public buildings. That the process of education is somewhat slower than the developments in the art, is scarcely to be wondered at, for the public is not accustomed to such progress as has been made in the last two or three years in illuminating engineering, and so is apt to listen with incredulity to the enthusiastic illumination solicitor who points out the excellence of his wares, and to class him among the authors of fairy tales of the past ages. Seeing is still believing, however, and as the number of modern installations increases, the number of people who fail to see them and so go unconvinced is rapidly decreasing. In the present article, we show a couple of examples of recent adjustments of the lighting equipment in two of Toronto's public buildings. One of these, St. Anne's Church, represents a class of building in which very noticeable developments are taking place all over Canada at the present time, the idea having taken firm hold apparently that good light, restful to

Fig. 1. A restful interior.

the eye and mind alike is quite as important in a church as in a theatre or other public building. The interior of St. Anne's is shown in Fig. 1. Here we have a typical high ceiling interior, where proper and effective illumination can only be attained with diffused lighting directed in such a way as to produce not only a sufficient intensity on the reading plane, but also to illuminate the general interior and bring out, to the best advantage, the beauty of the architecture, for which so many of our churches are becoming famous. Fig. 2 illustrates, to good advantage, the use of a semi-indirect system.

Fig. 2. As well lighted as your own home.

In this case the ceiling is of moderate height and, together with the walls, may be depended on to reflect a fair part of the light over their entire area. We lay special stress on the last words "entire area," because no semi-indirect system of lighting can be satisfactory or efficient if the conditions are such that a very large percentage of the ceiling at least cannot be utilized to redirect the light reflected up from the glass bowl.

To obtain proper lighting effects using the semi-indirect system, one must carefully analyze the conditions of the surrounding interior and co-relate with these the lighting units and reflectors that are to be used. Many efficient lighting units are rendered inefficient both from an illumination and an appearance standpoint because, for example, of improper suspension. Effectiveness and efficiency in semi-indirect lighting is dependent in a general way on four main factors: (a) position of outlet; (b) conditions of ceilings and walls; (c) distance of bowl from the ceiling, and, (d) last but not least, style, size and quality of the glassware.

Fig. 3 shows a simple but effective treatment of a beautiful deep acid etched and decorated semi-indirect bowl suitable for a residence. Fig. 4 is another semi-indirect bowl, plain but very efficient and specially adapted for the new nitrogen high efficiency lamp.

The glassware illustrated herewith represents a few typical examples of the products of the factory of the Jefferson Glass Company, Toronto, the only Canadian manufacturers of illuminating glassware. This company will upon request place their engineering department at the disposal of intending

purchasers. There is, therefore, no excuse for anyone going it blind, who has an installation of any considerable size in charge. Illuminating engineering to-day as a science has reached a very high stage of development. It is still possible, however, to equip a private or public building with a lighting system which is both inefficient and inartistic. It is equally true that, without added cost, advice may be obtained from

Fig. 3. A beautiful design.

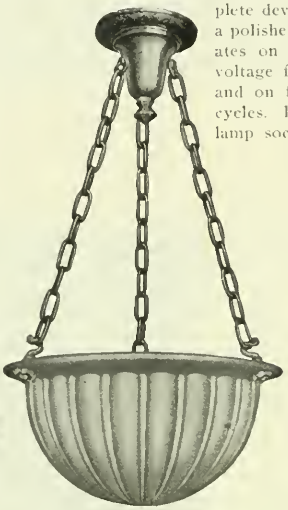
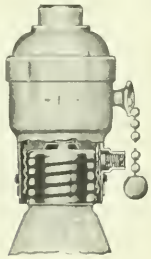


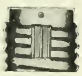
Fig. 4. Very efficient.

reliable sources, which will add from 50 to 100 per cent. in both. That advice may be obtained either as in the present case without cost, or through consulting engineering firms who specialize in illumination. The main point, however, we wish to make in this matter is that reliable advice should be obtained from some source, that mistakes of the past with its unnecessary extravagances may not be repeated.

A New Lock Socket

The accompanying illustrations represent a new lock socket just placed on the market by the Arrow Electric Company, Hartford, for which the Northern Electric Company are Canadian distributors. This device is known as the "Arrolock" socket. It prevents loss of lamps through theft and also prevents the use of high wattage lamps, heat-



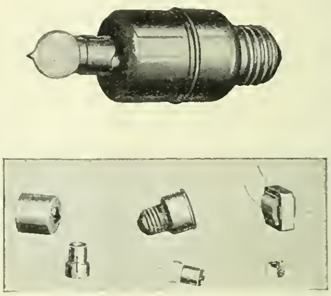


Arrolock socket — Cannot steal or change the lamp.

ing devices and other current consumers where the use of such articles is not desired. The "Arrolock" is attached to any brass shell type Arrow E socket. The operating device is simple, a small set screw being turned in against a serrated, hardened steel clamping piece, which engages with the lamp base. A special key is used to operate the set screw.

All-Nite-Lite Transformer

The All-Nite-Lite transformer, now being introduced by the Canadian General Electric Company, has been designed to meet the increasing demand for some more economical form of electric light for use in the all night illumination of such places as hospital-rooms, door-fronts, cellars, stairways, halls, bathrooms, telephone-booths, closets and other places where a small energy-consuming light is desired. The complete device consists of a miniature transformer contained in a polished brass shell, and a miniature mazda lamp. It operates on any alternating current supply circuit ranging in voltage from one hundred to one hundred and twenty-five, and on frequencies from fifty to one hundred and forty cycles. It is installed by simply screwing it into the standard lamp socket in place of the usual incandescent lamp. The



Low voltage, high efficiency night lamp.

transformer, although miniature in design, is constructed with liberally insulated primary and secondary coils, and with a core built of the highest grade of transformer steel punchings. Its function is to transform the normal supply voltage to about six or seven volts before it is supplied to the lamp. The receptacle for the lamp is designed to fit a rear and speedometer mazda automobile lamp, 2 c.p., 6 and 7 volts, 1.25 w.p.c., G-6 bulb with bayonet base. At the average cost of electricity, All-Nite-Lite transformer can be operated for ten hours at a total cost of less than four-tenths of a cent.

Personal

Mr. F. C. Carman, well known to the electrical trade, has joined the sales staff of the Radiant Electric Company, Grimsby, Ont.

Mr. J. Shields, consulting electrical contractor, has been appointed city inspector of wiring installations by the Toronto Hydro-electric Commission.

Mr. Charles H. Dudley, formerly of the Toronto Hydro-electric System, has accepted the position of sales manager of the Volt Electric Company, Limited, Toronto.

Mr. Joseph Showalter, chief engineer salesman of the meter department of the Ferranti Electrical Company of Canada, Limited, Toronto, has been appointed to succeed Mr. J. G. Monahan as manager of this company's Winnipeg branch.

Mr. Lawford Grant, general sales manager of Eugene Phillips Electrical Works, Limited, Montreal, is now on a visit to England.

Professor L. A. Herdt, of McGill University, has just returned from a visit to England and the European Continent.

Mr. J. H. Gunther, for many years manager of the Bell Telephone Exchange at Listowel, has resigned and will enter private business.

Mr. J. G. Jackson is local manager of the hydro-electric system in Chatham.

The Dealer and Contractor

Electric Gifts Most Appropriate

For Christmas—Suitable for Friends in Any Circumstances or of Any Age—Fit Every Pocket

Supplementing our article of November 1st on electric toys for the Christmas trade, we are reproducing in the present issue, herewith, further suggestions and illustrations of the more useful class of electrical appliances. So great has been the attention paid in recent years by electrical manufacturers in general to this type of equipment, and so successful have they been in meeting the popular demand for articles that are both useful and luxurious, and at the same time efficient and economical, that the majority of electrical appliances now on the market must rather be classed as necessaries than luxuries, and this indeed is the light in which actual users of these articles, those who have learned their value from personal experience, do nowadays look upon their electrical appliances.

The sale of electrical appliances for Christmas gifts has every reasonable argument in its favor. The prices of the articles are such as the majority of people can pay. The appropriateness for all classes, all ages and both sexes is unquestioned. Finally, as a constant pleasant reminder of the giver it has no equal, for each day the electrical appliance brings added pleasure and appreciation. The central station further gains by encouraging the purchase of electrical equipment as each purchase means increased current consumption and added revenue. Christmas is essentially a time of rejoicing and we believe there is no development of the past century that has added and will yet add so much to the capacity of the human being for real, solid, permanent enjoyment as the application of electricity in its various and varied forms to the one hundred and one labor-saving, pleasure-giving household appliances. For these reasons, we submit that jobbers and central stations should use every effort to make this the biggest electrical Christmas yet, strong in the assurance that, while it is good business for themselves, they are also prosecuting a campaign that will have far-reaching effects in raising the standard of human knowledge and intelligence, and in increasing our capacity for work as well as pleasure.

Getting nothing more than he deserves.—Who does not envy him?

A few brief descriptive comments referring to the articles illustrated on the following pages are given herewith,—

Figs. 1 to 6 inclusive represent a number of useful and efficient household appliances manufactured by the Northern Electric Company, Limited, Montreal. Fig. 1 is a curling iron heater, applicable to any size iron; Fig. 2, a very useful chafing dish. Fig. 3 represents a toaster stove with which a meal can be prepared right on the dining table. Fig. 4 is a percolator which insures you a cup of best quality coffee in a minimum of time and at a minimum expenditure. The toaster shown in Fig. 5 makes two slices of bread at once into crisp, delicious toast. Fig. 6 represents the "American Beauty" iron, weighing 6½ lbs.

Figs. 7, 8, 9 and 10 show representative Canadian Westinghouse equipment. Fig. 7 indicates how easily and luxuriously a breakfast may be prepared on the dining table. Fig. 8 is an attractive looking and comfortable feeling three-glow heater. Fig. 9 is a utility motor, which may be used to operate grinders of various sorts, polishers, etc. Fig. 10 represents another form of toaster.

Fig. 11 illustrates one form of coffee percolator handled by the Canadian General Electric Company. The value of an electric percolator in the home can scarcely be over-estimated. The coffee begins to percolate in less than two minutes and a delicious cup of this stimulating beverage is ready for use in a minimum of time. Fig. 12 shows an attractive table lamp representing one of a very large number of designs handled by this company.

Fig. 13 represents the "Ideal" smoothing iron manufactured by the Ideal Electric Manufacturing Company, Wallaceburg, Ont. Note that this electric iron is pointed at

both ends, thus facilitating the work and reducing the time spent on many such articles as shirt-waists, children's dresses, etc. These irons are guaranteed for ten years. This article is representative of a general variety of appliances manufactured by this company, including toasters, disc stoves, radiators, percolators, etc.

Fig. 14—Typical of the well-known products of the Canadian Hotpoint Electric Heating Company, to which the trade name El Perco, meaning excellent percolator, has been given.

Fig. 15—A flash light handled by the Canadian Carbon Company and equipped with their well-known "Nine Lives" battery.

Fig. 16—An instantaneous hot water heater handled by the Volt Electric Company, Toronto. This is an exceedingly useful gift, especially for the man friend who is often impatient at the length of time it takes to heat his shaving water in the morning.

Fig. 17—A small portable oven suitable for light housekeeping, manufactured by the Radiant Electric Company, Grimsby. It is typical of a number of various designs of stove manufactured by this company.

Fig. 18—The Tuec stationary vacuum cleaner, manufactured by J. J .Martindale, Toronto. Stationary cleaners are already being placed in all the new buildings of any considerable size and according to present indications will soon be considered essentials in every residence except those of very insignificant dimensions.

Fig. 19 represents the well-known 1900 washing machine, an efficient washer electrically operated. No Christmas present would be more appreciated by the thrifty housewife in these days of strict economy.

Fig. 20—A warming pad manufactured by the Radiant Electric Company, Grimsby. It is especially useful for elderly people, either during the day or after retiring. As a face warmer, back warmer or foot warmer it is entirely replacing, both in convenience and safety, the other forms of similar devices now on the market. Fig. 21 represents another product of the Radiant Electric Company—a water heater with self-contained unit. This type of appliance is one of the most efficient as well as one of the most useful on the market today.

Fig. 22 represents a small iron typical of a number of sizes handled by the Canadian General Electric Company.

Fig. 23—A small but efficient portable type cleaner, manufactured by the Duntley Products Company, of Erie Pa.

Fig. 24 represents a small portable cleaner well known throughout the Dominion, that of the Onward Manufacturing Company, Berlin. The cost of operating this cleaner is about the same as to light one ordinary capacity lamp, and it does the work of cleaning easily and expeditiously.

Fig. 25 is a decorative type of portable lamp manufactured by the Canadian General Electric Company, Toronto.

Figs. 26 and 27 are further representative of the dining table equipment of the Canadian Westinghouse Company. Fig. 26 is a coffee percolator; Fig. 27, a tea samovar, both of them splendid examples of today's possibilities of luxurious living at a minimum cost.

Fig. 28—A small stove manufactured by the Hughes Electric Heating Company, Chicago. This company has made strenuous efforts to capture the trade of western and central Canada, and their measure of success speaks well for the quality of their ranges.

Fig. 29—A toy transformer manufactured by the Electric Manufacturing Company, Baltimore.

Fig. 30—Another form of range manufactured by the Hughes Electric Heating Company, Chicago.

Fig. 31 represents one form of a very efficient house warmer handled by the Masco Company. This warmer is so controlled that a graded heat may be obtained almost automatically. Fig. 32 represents another line handled by the Masco Company, a massage vibrator. To the tired back or the haggard and worn face nothing has more invigorating effects than an electric vibrator. The cost of operation is negligible.

Fig. 33—Another utility manufactured by the Canadian General Electric Company—a chafing dish—one of the most universally appreciated pieces of household equipment on the market today.

Fig. 34—A door-bell transformer manufactured by the Electric Manufacturing Company of Baltimore.

Fig. 35—An electrically-operated night clock, handled by F. I. Spielmann, Montreal. This clock is suspended on a swivel and may be so adjusted and illuminated as to throw the image of the dial on the wall or ceiling or any point most convenient to the occupant of the room as he lies in bed. See also Fig. 64.

Figs. 36 and 37 are typical of the products handled by the Canadian Laco-Philips Company. Fig. 36 is their well-known projector lamp. Fig. 37 is a very efficient lamp for both night and day burning. By day this is a 35 watt 27 c.p. light, and by night a 5 watt 3 c.p. unit.

Fig. 38—One of the designs of tea samovar handled by the Canadian General Electric Company.

Fig. 39—Coffee percolator of the Simplex Electric Heating Company, Belleville.

Fig. 40—One of a variety of portable lamps carried in stock by F. I. Spielmann, Montreal.

Fig. 41—An electric comb for hair drying—handled by the Volt Electric Company, Toronto.

Fig. 42—One type of smoothing iron manufactured by the Simplex Electric Heating Company.

Fig. 43—The well-known "Seafoam" electric washer and wringer manufactured by Cummer-Dowswell Limited, Hamilton.

Fig. 44—A head-piece suitable for the amateur wireless telegraph operator. Manufactured by Holtzer-Cabot Electric Company, Brookline, Mass.

Fig. 45—A small size flash light manufactured by the Canadian Carbon Company. This flash light also is equipped with the well-known "Nine Lives" batteries.

Fig. 46—Another of the products of the Volt Electric Company—an efficient smoothing iron.

Fig. 47—One of a number of household appliances manufactured by the American Electrical Heater Company, of Detroit. The agency for this company is held by the Northern Electric Company, Limited, Montreal.

Fig. 48—A very useful article in the form of a universal drier, handled by R. E. T. Pringle, Toronto. This drier may be used for hair drying, face drying, shoe drying or any of the many other drying operations so common in the average home.

Fig. 49—Another form of coffee percolator, manufactured by the American Electrical Heater Company, Detroit. Fig. 50 is a rapid water heater by the same company.

Fig. 51—Another of the products handled by the Volt Electric Company—a rapid electric toaster.

Fig. 52—A hot plate manufactured by the Hughes Electric Heating Company, Chicago, Ill. Such a hot plate can be used for a very large and varied number of household operations, and as a Christmas present would be fully appreciated by anyone interested in the preparation of light meals.

Fig. 53—Another form of the Duntley portable vacuum cleaner of larger capacity than that shown in Fig. 23.

Fig. 54—Another type of coffee percolator manufactured by the American Electrical Heater Company, Detroit. Fig. 55—An electric iron showing in the background a Christmas box suitably decorated for Christmas giving.

Figs. 56 and 57 are illustrative of a very efficient toaster and radiator, named respectively El Tosto and El Radio,

(Continued on page 42)

Fig. 1 -Curling iron heater- -Northern Electric Company, Montreal.

Fig. 2 -- Chafing dish -- Northern Electric Company, Montreal.

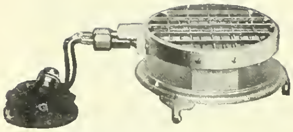


Fig. 3—Grill—Northern Electric Company, Montreal.

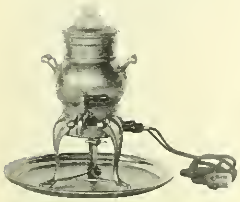


Fig. 4 — Coffee percolator - Northern Electric Company, Montreal.

Fig. 5—Toaster -Northern Electric Company, Montreal.

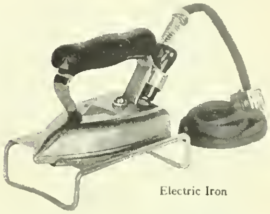


Fig. 6—Electric iron — Northern Electric Company, Montreal.

Fig. 7—The electric breakfast — Canadian Westinghouse Company, Hamilton.

Fig. 8 — Luminous radiator — Canadian Westinghouse Company, Hamilton.

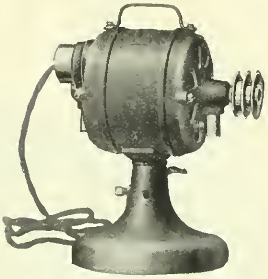


Fig. 9 Utility motor—Canadian Westinghouse Company, Hamilton.

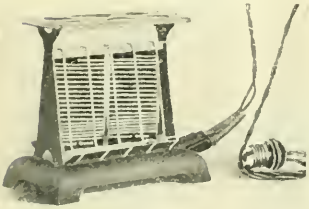


Fig. 10 -Vertical toaster -Canadian Westinghouse Company, Hamilton.

Fig. 11 — Coffee percolator — Canadian General Electric Company, Toronto.

Fig. 12 — Table lamp Canadian General Electric Company, Toronto.

Fig. 13 Electric iron—Ideal Electric Manufacturing Company, Wallaceburg, Ont.

Fig. 14 Coffee percolator -Canadian Hotpoint Electric Heating Company, Toronto.

Fig. 15 "Nine lives" flashlight—Canadian Carbon Company, Toronto.

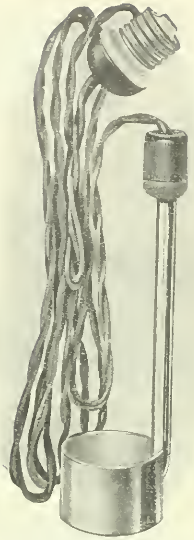


Fig. 16 Instantaneous Water Heater-Volt Electric Company, Toronto.

Fig. 17—Electric oven—Radiant Electric Company, Grimsby, Ont.

Fig. 18—Stationary cleaner—United Electric Company, Toronto.

Fig. 19—Washing machine—1900 Washer Company, Toronto.

Fig. 20—Warming pad—Radiant Electric Company, Grimsby, Ont.

Fig. 22—Smoothing iron—Canadian General Electric Company, Toronto.

Fig. 21—Tea kettle—Radiant Electric Company, Grimsby, Ont.

Fig. 23—Portable cleaner—Duntley Products Company, Erie, Pa.

Fig. 24 Portable cleaner—Onward Manufacturing Company, Berlin, Ont.

Fig. 25 Portable table lamp—Canadian General Electric Company, Toronto.

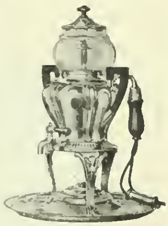


Fig. 26 Coffee percolator—Canadian Westinghouse Company, Hamilton.

Fig. 27 Tea samovar—Canadian Westinghouse Company, Hamilton.

Fig. 28—Portable oven Hughes Electric Heating Company, Chicago, Ill.

Fig. 32 Massage vibrator—The Masco Company, Toronto.

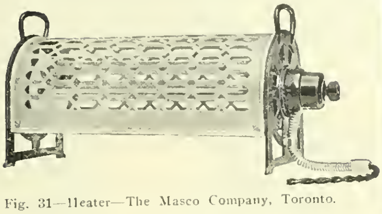


Fig. 31—Heater—The Masco Company, Toronto.

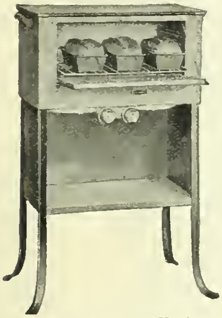


Fig. 30 Bake oven—Hughes Electric Heating Company, Chicago, Ill.

Fig. 34—Bell ringing transformer—Electric Manufacturing Company, Baltimore, Md.

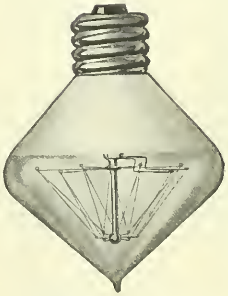


Fig. 36—Projector lamp—Canadian Laco-Philips Company, Toronto.

Fig. 37—Dimbrite—Canadian Laco-Philips Company, oronto.

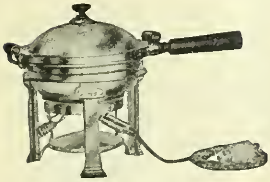


Fig. 33—Chafing dish—Canadian General Electric Company, Toronto.

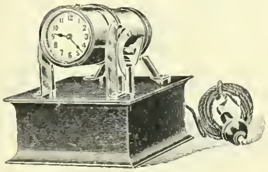


Fig. 35—Ceiling clock—F. I. Spielmann, Montreal.

Fig. 38—Tea samovar—Canadian General Electric Company, Toronto.

Fig. 39—Coffee percolator—Simplex Electric Heating Company, Belleville, Ont.

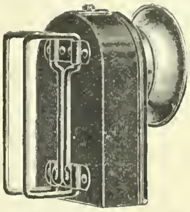


Fig. 40—Flash light—F. I. Spielmann, Montreal.

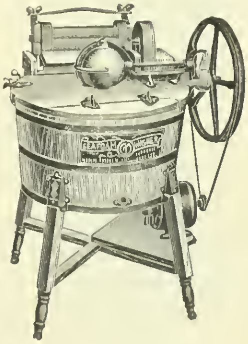


Fig. 43 Washing machine—Cummer Dowswell Limited, Hamilton.

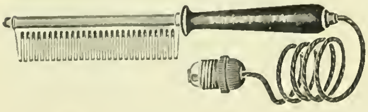


Fig. 41—Electric comb Volt Electric Company, Toronto.

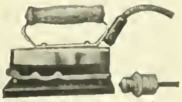


Fig. 42—Household iron—Simplex Electric Heating Company, Belleville, Ont.

Fig. 44 Wireless receiver -- Holtzer-Cabot Electric Company, Brookline, Mass.

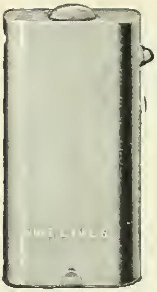


Fig. 45—Pocket flash light — Canadian Carbon Company, Toronto.

Fig. 48 Universal drier R. E. T. Pringle, Toronto.

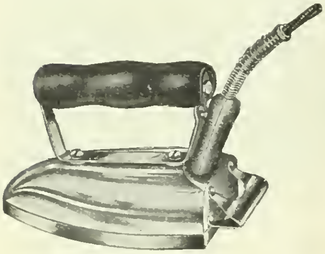


Fig. 46—Electric iron—Volt Electric Company, Toronto.

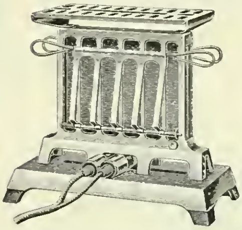


Fig. 47—Toaster — American Electrical H ater Company, Detroit, Mich.

Fig. 49—Coffee percolator—American Electrical Heater Company, Detroit, Mich.

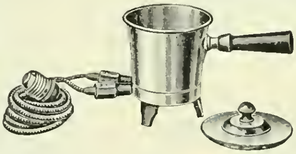


Fig. 50—Water heater — American Electrical Heater Company, Detroit, Mich.

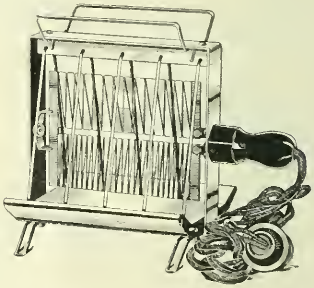


Fig. 51—Toaster—Volt Electric Company, Toronto.

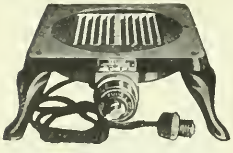


Fig. 52—Hot plate—Hughes Electric Heating Company, Chicago, Ill.

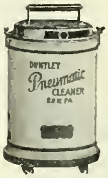


Fig. 53—Portable cleaner—Duntley Products Company, Erie, Pa.

Fig. 54—Coffee percolator—American Electrical Heater Company, Detroit, Mich.

Fig. 55 Electric iron—American Electrical Heater Company, Detroit, Mich.

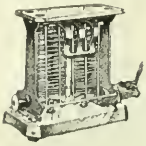


Fig. 56 — Toaster — Canadian Hotpoint Electric Heating Company, Toronto.

Fig. 57 -Radiator — Canadian Hotpoint Electric Heating Company, Toronto.

Fig. 58—Warming pad—Northern Electric Company, Limited, Montreal.

Fig. 59—Portable cleaner — Canadian General Electric Company, Toronto.

Fig. 60—Universal cleaner—Invincible Renovator Company, Toronto.

Fig. 61 — Toaster — Simplex Electric Heating Company, Belleville, Ont.

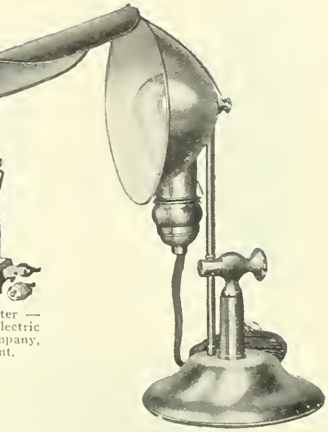


Fig. 62—Reading lamp Irving Smith, Montreal.

Fig. 63—Coffee percolator — American Electrical Heater Company, Detroit, Mich.

Fig. 64—Ceiling clock—F. I. Spielmann, Montreal.

Fig. 65 — Utility motor — Northern Electric Company, Limited, Montreal.

Fig. 66—Curling tongs heater—American Electrical Heater Company, Detroit, Mich.

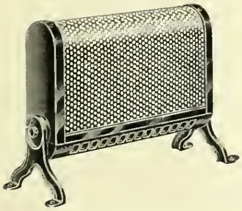


Fig. 67—Portable heater—American Electrical Heater Company, Detroit, Mich.

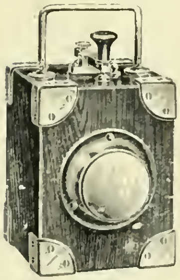


Fig. 68—Portable storage lamp—F. I. Spielmann, Montreal.

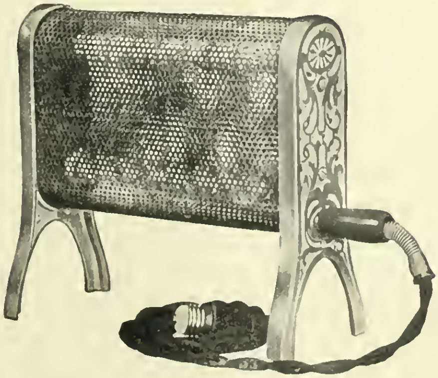


Fig. 69—Portable heater—National Electric Heating Company, Toronto.

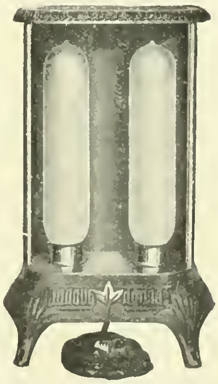


Fig. 70—Two glow portable—National Electric Heating Company, Toronto.

Fig. 71—Handy lamp—Canadian Ever Ready Works, Toronto.

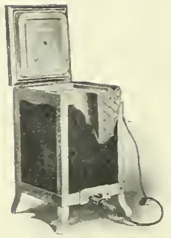


Fig. 72—Fireless cooker—Standard Electric Stove Co., Toledo.

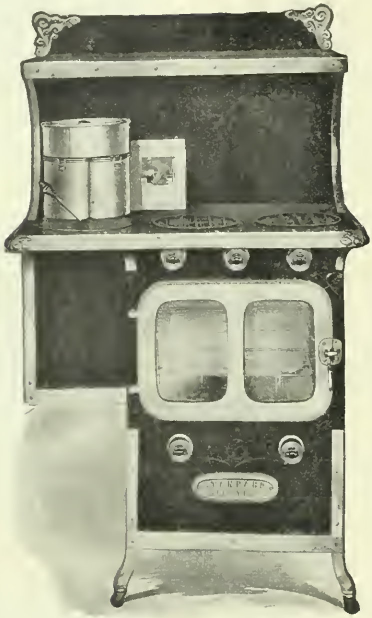


Fig. 73 - Electric range--Standard Electric Stove Co., Toledo, O.

manufactured by the Canadian Hotpoint Electric Heating Company, Toronto.

Fig. 58—One of the various uses to which a warming pad may be put. This type is manufactured by the Northern Electric Company, Limited, Montreal.

Fig. 59—A new type of small portable cleaner, the Big Ben, at popular price, now being placed on the market by the Canadian General Electric Company. Though these small cleaners may not be as powerful as the larger and more expensive machines, they can be depended upon to give entirely satisfactory service.

Fig. 60—A form of portable universal cleaner, manufactured in Canada by the Invincible Renovator Company of Toronto. The various operations illustrated indicate the universal application of this machine to all sorts of household cleaning. The Invincible Company have long made the heavier cleaners of highest quality and are now bringing out the Baby Invincible, maintaining the same quality and tool equipment as used on the high priced machines, and at a price within reach of all. The Baby cleaner weighs 10¼ pounds, and costs less than one-half cent per hour to operate.

Fig. 61—Another of the efficient household units manufactured by the Simplex Electric Heating Company, Belleville—a popular priced toaster.

Fig. 62 illustrates what is known as the Lyhne lamp. This lamp is so equipped with shades that the light may be directed and concentrated in any desired position. It is alike useful in the home and in the office. Mr. Irving Smith, Montreal, is the sole Canadian agent.

Fig. 63—Another of the products of the American Electrical Heater Company, Detroit.

Fig. 64—Another view of the F. I. Spielmann night clock, showing the dial projected on the ceiling.

Fig. 65—A utility motor being put to good use in the electrical home. This is one of the most satisfactory labor-saving devices yet manufactured for the electrical trade; can be used to operate sewing machines, grind knives, operate lathes, polishers, etc.; Northern Electric Company, Montreal.

Fig. 66—Another product of the American Electrical Heater Company—a curling tongs heater. Fig. 67 shows a small portable heater also manufactured by this company.

Fig. 68—One of the types of storage lamp handled by F. I. Spielmann.

Figs. 69 and 70 represent two very popular types of electric heater manufactured by the National Electric Heating Company, Queen Street East, Toronto. The stove shown in Fig. 69 consumes 660 watts and is capable of keeping any ordinary room at a comfortable temperature during the late autumn or early spring days when the furnace may not be operating at full capacity. For auxiliary work in extreme weather this electric stove is also an exceedingly valuable asset. Fig. 70 represents a more decorative type, though somewhat less efficient.

Fig. 71 is a product of the Canadian Ever Ready Works, Toronto—a useful portable light which takes a standard 6-inch dry-cell and will give from 20 to 40 hours' service, depending on whether or not it is used continuously. This is an article especially adapted for farm or other country use, and is invaluable to meter readers, plumbers, watchmen or wherever a bright, safe, instantaneous light is required.

Figs. 72 and 73 represent types of stove manufactured by the Standard Electric Stove Company, Toledo, Ohio. Fig. 72 is a smaller type built entirely on the fireless plan. Fig. 73 is a combination of two luminous disc heaters and two aluminium lined insulated cooking compartments or ovens, one with glass front in the oven door for quick baking, roasting, toasting, etc., and one perpendicular, operating with "Water-seal" cover, designed to cook in the fireless way.

Those Old Fashioned Fixtures

There is a big field awaiting the electrical contractor in homes built and wired eight or ten years ago and fitted according to the requirements and ideas of that period. Electrical installations ten years old are, in the majority of cases, out of date; the fixtures are old-fashioned and uneconomical; the outlets are in the wrong place; and, for the most part, the carrying capacity of the circuits is not sufficient to meet today's demand for the variety of household electrical appliances that have come to be looked upon as necessities.

Many such householders realize the handicaps they are operating under, and speak of the day when they will build a new home properly equipped with all the modern devices, and they do not realize that a comparatively small expenditure would renovate their present system of wiring and make it, if not equal to the best, at least a great deal better than it is at present. The current issue of the National Electrical

Contractor discusses this point, emphasizing the fact that electrical contractors are tumbling over one another to secure a small job in the wiring of a new house, but are entirely neglecting these larger opportunities, and adds:

A study of conditions in the electrical contracting field shows that ninety per cent. of present selling efforts are spent on new buildings or on old buildings not wired for electricity. Naturally these jobs are decidedly competitive and in a number of cases the work is handled at an actual loss.

One difficulty here is the lack of appreciation on the part of the consumer as to what constitutes a well-lighted home. Their ideas on lighting are gathered from the old-fashioned installations they have seen in other homes, and naturally the contractor who talks modern designs has a difficult wall to mount.

Let us take, for example, a typical small town, in which the lighting plant has been operating for ten years. In this town, which is composed largely of retired farmers, seventy per cent. of the houses were wired for electricity when the plant was put in operation. Inexpensive chandeliers of the angle arm type were generally used for the parlor and living room, while drop cords made up the bulk of equipment for other parts of the house.

The houses in this town are probably above the average in size, construction and furnishings, yet the chandeliers are entirely lacking in harmony with the modern furnishings which have replaced those which were in the homes at the time the chandeliers were installed.

When a new house is built here three electrical contractors and the lighting company cut each other's throat in an effort to secure the chandelier work, yet no effort has ever been made to induce these well-to-do owners of homes built ten or twelve years ago to buy chandeliers in keeping with their modern furnishings.

Growth of population in towns of this class is slow. Fifteen new houses a year would tax the resources of the building contractors to the utmost. Yet the writer found twenty-five homes of men rated at $10,000 and over—men who drove $2,500 automobiles, owned $600 pianos and $450 victrolas—in which the lighting equipment did not exceed two $15 chandeliers. Rooms not generally visited by strangers were almost universally fitted with drop cords.

Properly approached, the owners of any of these homes were live prospects for a $100 or $150 chandelier order. An appeal to their pride, comfort, or some other personal weakness which could be connected with the use of better chandeliers, would have put them in a buying frame of mind. Still the local contractors had never considered them as prospects.

As near as we can learn this is not an unusual case, excepting possibly that the wealth of the unworked prospects was above the average. The trouble seems to be that the contractors are too close to their market to view it in proper perspective. A new job which includes wiring, etc., attracts them immediately, but owing to present day competitive methods it frequently results in no actual profit.

What would prevent a live electrical contractor, located in one of the thousands of towns similar to the one described, from building a profitable department for his business through the sale of one or more modern chandeliers to these owners of old homes.

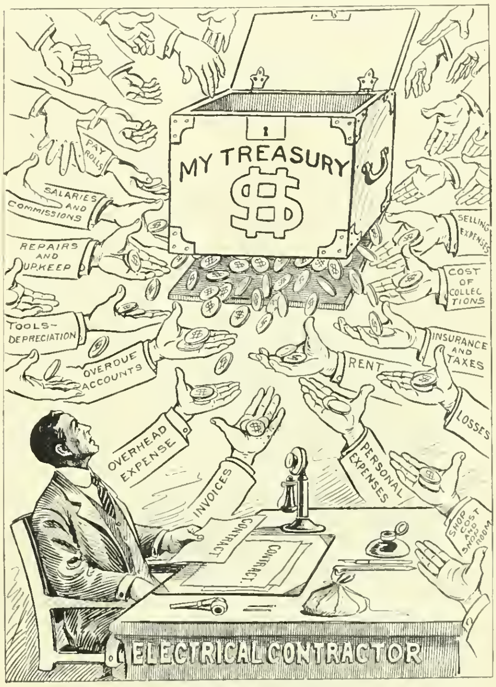
After the plan was put in operation there would be some competition, of course. But it would be a competition of quality rather than price, and in most cases the competitive feature would not figure as the prospects would not be in the shopping mood.

New contracts are desirable, to be sure. Fixture manufacturers want them, and want electrical contractors to get them. But the field described is equally desirable. It is infinitely larger, it can be worked at any season and it gets away from the price-cutting evil because competitors can not learn where the electrical contractor is concentrating his efforts.

In addition to this, the sale of these new type chandeliers will mean the sale of new lamps, and will prepare the way for the sale of other electrical household devices which will add to the contractor's profitable business.

The Unsuccessful Contractor

This is the way the National Electrical Contractor explains the failure of so many so-called electrical contractors to make good. It evidently needs a pretty efficient accounting system to take correct note of all the little leaks, but it



seems to be the only way. Otherwise it is inevitable that sooner or later the bottom falls out of your treasury—and your business—and you are numbered with the majority.

Weston Electrical Testing Instruments for the Garage

Electrical measuring instruments are urgently needed in all well-equipped public garages at the present time. The reason they are needed is that one of the most useful and permanent advances in connection with gasoline automobiles has been the introduction of electric starting and electric lighting systems on substantially all gasoline automobiles of recent model. Until two or three years ago the electrical circuits of a gasoline automobile consisted mainly of such wiring as was required for the ignition system, and while electrical measuring instruments have always been desirable as a part of a garage equipment, they were not heretofore indispensable. This condition has changed, however, because the extensive use of the present-day electrical equipments will necessarily increase the number of causes that may interfere with the satisfactory operation of a car, and consequently garages must be prepared to remedy electrical troubles of a nature that did not exist previously.

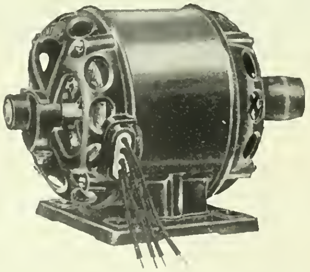
Weston Model 280 volt-ammeter, with external shunts

for ampere measurements, is designated the Weston Garage Testing Instrument, and is superior to any instrument of its character and size that has ever been offered for sale. The selection of ranges is that which experience has demonstrated to be the best combination for the large number of garages that feel compelled to limit their electrical testing investment to the purchase of a single instrument. This instrument is extremely serviceable, and will prove of invaluable assistance to the employees in any garage. It is compact (pocket size), has a uniform and legible scale, is extremely accurate and serviceable, perfectly dead-beat, quick in action, shielded from the disturbing influence of external magnetic fields, exceptionally permanent and durable. It is adjusted for ranges of 30 and 3 volts and 100 millivolts (all self-contained), and is provided with external shunts of 3, 30 and 300 ampere-rating for use in current measurements.

As an indication of the serviceability of these various ranges, the 30-volt range is useful for determining the voltage of the starting or lighting system of batteries. The 3-volt range is of service in testing the individual storage batteries. The 100-millivolt range may be used to determine the "drop" over segments of the commutator of the motor or generator. The 3-ampere range is of value in testing the current required by single lights. The 30-ampere range will denote the current required by a complete lighting circuit or the magnitude of leaks. The 300-ampere range is useful to determine the starting current. The foregoing are merely a few of the tests that may be made with the instrument, but they serve to show the variety of tests that are made in a garage, to which any make of automobile and hence any make of electric-starting, lighting or ignition system may be brought for attention. These testing instruments are for sale by the Northern Electric Company, Limited, who are Canadian agents for the Weston Electrical Instrument Company, Newark, N.J.

Starts Under Full Load

The Century Electric Company, St. Louis, are meeting the demand among central station operators for a small a.c. motor capable of starting under full load with a low starting current by the addition of a 1-6 h.p. motor to their regular line. This motor is capable of starting on the small fuses



New Century 1-6 h.p. a.c. motor.

usually found in residence districts, develops a high torque and is of the repulsion starting, induction running type.

The same general design and construction prevails in this motor that is characteristic of the remainder of the "Century" line. It is capable of developing a starting torque more than two and one-half times full load torque with a starting current of less than three times full load current, and capable of developing a maximum, when it is up to speed, of approximately 200 per cent. of full load torque. It is equipped with phosphor bronze ring oiling bearings which makes it especially valuable for the operation of apparatus which is located in places where the motor is subjected to low winter temperatures. The standard winding is 104-208 volts interchangeable which enables the manufacturer to equip his apparatus with motors and put the complete equipment in stock with reasonable assurance that the motor can be used on either of the prevailing voltages usually found in this country.

A Salesmen's Convention

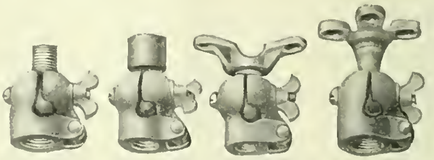
The Robbins & Meyers Company, Springfield, O., held their annual convention of branch house managers during the week of October 19th. In addition to the managers, each branch house had one or two salesmen in attendance. Among

An ideal convention headquarters.

the business features of the convention may be mentioned the discussion of such subjects as credits and advertising, the sale of fans, the sale of motors, and so on. At the close of the general conference, the whole party was carried in the company's motor trucks to the Log Cabin, the forest camp belonging to Mr. Warren Myers, where refreshments and a general good time were served. The accompanying illustration shows the pleasurable conditions under which this final session was held.

Hangstrait Hickey

There are few jobs where the wireman or fixture hanger finds outlet boxes level, or studs or drops straight, or where he does not run into crooked threads which finally have the same result. To relieve these troubles of the past there has been developed a new approved adjustable ball and socket joint hickey with an angle of possible correction sufficient to take care of a fixture 12 ins. long that will be 4 ins. off centre, or a 6-ft. fixture 24 ins. out of plumb. By a slight cutting off



Adjustable ball and socket hickey.

of the corners of one side of the cup with file or emery wheel the angle of pitch may even extend beyond 45 deg.—a feature very valuable when outlets occur on a sloping ceiling such as is found with saw tooth construction or under theatre balconies, stairways, etc. The new hickey is made of high grade malleable iron, and is of great mechanical strength, small, neat, compact, and low in price. It is furnished complete

with a tripod, crow-foot or outlet box stud or made to fit insulating joints, the bottom of which may be either male or female, ¼-in. or ⅜-in. standard pipe size, and to connect to fixture stems of ⅛-in., ¼-in. or ⅜-in. standard pipe size. The minimum overall length of this hickey with an insulating joint is less than one-inch greater than the ordinary hickey and insulating joint. As a time saver it is a 10 per cent. to 50 per cent. reduction on the average cost of hanging electric fixtures. One man can handle any fixture not too heavy to lift. Long arm, wide spread fixtures are just as simply and easily hung as the plain stem fixture as there is no turning or twisting of the fixture necessary. After the crow-foot or insulating joint with the ball fitting has been attached, the fixture is hung by slipping the bolt through the hole in the ball, swinging up the hinged half of the cup or socket and screwing up the wing nut. The fixture hangs plumb and cannot twist or swing. A tightening of wing nut leaves the joint rigid. The trade name Wico Hangstrait Hickey has been given to this new article. It is manufactured by the Wilton Manufacturing Company, Wrightsville, Pa.

New Molded Insulation Cover

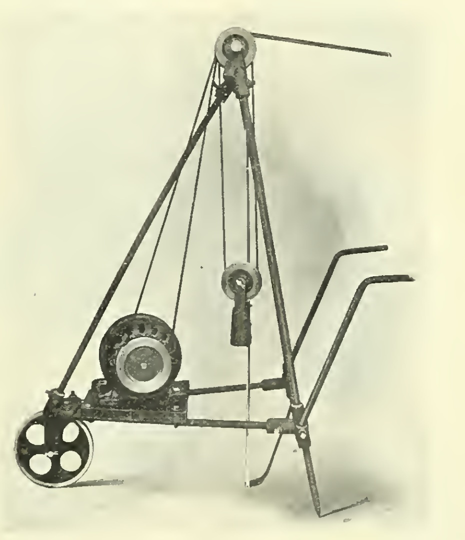
There has been a demand for a connector having an insulated cover, for use without solder for the small sizes of wires. Heretofore this demand has been partly met by the Dossert Special No. 1 connector but as this connector was designed to take all sizes of wire and cable from No. 1 to No. 14, the range was believed to be wider than necessary. Through Mr. Irving Smith, Montreal, Canadian representative, Dossert & Company, New York, announce a molded insulation cover for use on their regular No. 4 connector. This connector will take all sizes of wire from No. 4 to No. 14. By making the insulating cover for the regular No. 4 connector the fitting is reduced in size and with less material there is also a reduction in cost, to users, of about 20 per cent. as compared with the cost of the connector and cover heretofore supplied for small sizes of wire. With these connectors various size bushings are provided, the outside diameters of which fit the connector while the inside diameters correspond to the size of wire that it is desired to connect.

Manufacturing Electric Toys

The Perkins Electric Company, Limited, Montreal, have entered the field of manufacturing electric toys, for which Canada has hitherto had to depend almost entirely on outside supplies. The company are now engaged in this new branch, and will be in a position to make deliveries in time for the Christmas trade. Three lines are being made in Montreal—one, a small electric motor, which can be operated on any voltage between 2 and 8, one dry cell being required for every two volts. The apparatus is fitted with pulley, enabling it to be used for driving other toys and light articles. Another line, a small medical or shocking coil, of neat design, can be operated from one dry cell. The third line is a controller, principally for use with electrical trains, and is manufactured for use direct from the house service circuit. We are informed that the trade is very generously supporting the efforts of the company to create a new industry, and that orders for forward delivery should be received promptly

A Device of Special Interest to Planing Machine Owners and Operators

Modern planers and matchers are equipped with thin high speed steel knives which are most conveniently and with little loss of time, ground keen in the cutterheads on the machine. An Universal Grinder which may be used on any planer of the make it is built for, is used for this purpose, and is driven by any one of several different types of power rigs, one of which is illustrated. The rig shown here is probably the most convenient to use where current is available and where several planers are installed. It is called The Berlin Portable Tripod Power Plant by its makers, the Berlin Machine Works, Limited, Hamilton, Ont., and is intended specifically for use in connection with planing machines of that firm's make, for furnishing power for the Universal grinders with which their planers are equipped. It is a very simple and thoroughly efficient little appliance, consisting of a ¾ h.p. electric motor mounted in a portable steel tripod, two legs of which are pointed to stably position the rig wherever anchored. The third leg is mounted on a cast iron wheel, and it will be seen that the device may be easily moved about and positioned as desired. In some mills one of these rigs is taking care of the knife-grinding requirements of several machines. To complete the adaptability of the rig the motor will be furnished for either alternating or direct-current, complete with starting mechanism, where the latter is necessary. The alternating current motor is of the constant speed induction type, while the one furnished for direct current use is of the constant speed, shunt wound



Portable tripod power plant.

type. Current for the motor is taken through any ordinary lamp socket, or special wall boxes may be provided. Round belts running in deep-grooved sheaves transmit power from the motor to the grinder. A weighted sheave in the tripod works freely up and down on a square steel rod as the operator slides the grinder back and forth across the knives, keeping the belt always at the proper tension.

For the Christmas Trade

The Canadian General Electric Company, Limited, expect to offer in time for the Christmas trade, a new and up-to-date heating device in the form of an inexpensive Electric Utility Grill. This grill, while inexpensive, will be very substantially built and the field for its usefulness as a domestic appliance will be very wide. This grill may be used as a stove, as a toaster, as a broiler or as a grill. It will have a radiant spiral wound coil unit of 600 watts capacity, single heat, and will be supplied with attachment plug, six feet of cable and socket attaching plug.

Opened Offices as Manufacturers' Agent

Mr. Chas. B. Ellis, until recently manager of the Economy Fuse & Manufacturing Company of Canada, Limited, has opened an office at 301 Power Building, Montreal, as manufacturers' agent. Among other lines, Mr. Ellis is handling the exclusive agency for the Dominion of the Beers Electric Hand Lantern, manufactured by the Bridgeport Metal Goods Manufacturing Company. This lantern operates on an ordinary No. 6 dry cell and is a very popular line.

Universal Insulator Supports

The Steel City Electric Company, Pittsburgh, are placing on the market a number of new designs in their Universal insulator supports. Fig. 1 shows a one-inch support with two No. 5½ split insulators. The support is tapped special-

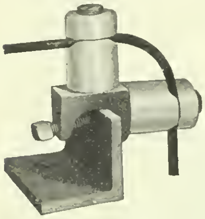


Fig. 1

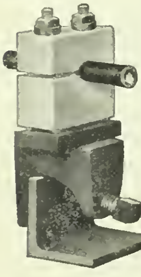


Fig. 2

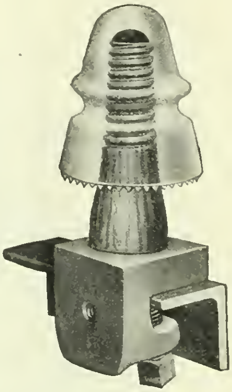


Fig. 3

ly for 10-24 thread machine screw. Fig. 2 shows a two-inch support with attachment for type 8 No. 2 B & D cleat. Support is tapped standard for No. 24-16 thread machine screw. Fig. 3 shows a 2½ inch support with wood pin and D.G., D. P. glass insulator. Support is tapped standard ½-inch 13 thread for sherardized bolt which goes through centre of wood pin.

Must Use Full Capacity Switches

The following letter has been sent out by the Hydro-electric Power Commission of Ontario, and settles a point about which there has been considerable controversy. The information contained therein will be of interest to many of our readers.

November 7th, 1914.

Dear Sirs,

A considerable amount of misunderstanding has occurred throughout the Province between electrical contractors and the inspectors as to the correct interpretation regarding 600-Volt Knife Switches. We therefore wish to advise you as to the correct understanding in order to obviate any inconvenience or loss of time to any parties concerned.

The point at issue between the principals in these discussions is whether the 500-Volt switch is permissable on a 550-Volt circuit. The correct decision in this matter and the one which will be enforced by inspectors under our jurisdiction is as follows:

That all approved knife switches marked 250 volts d.c. or 500 volts a.c. are only permitted for use on circuits where there is a maximum difference of potential not exceeding 500 volts a.c. Where the pressure is between 500 and 600 volts the specification for 600-volt switches will be called for. It is, however, permissable to use the former switches on 550-volt circuits providing there are proper barriers between the blades.

With reference to the words "proper barriers," we would pont out that make-shift barriers such as strips of asbestos or other substitutes will not be acceptable, and we would suggest that at your convenience you submit a sample of this style of switch and receive formal approval of the same.

Yours truly,

Hydro-electric Power Commission of Ontario,

Chief Engineer.

Appoint Canadian Agents

The General Devices & Fittings Company announce that they have appointed the following agents to look after their Canadian interests:—

Bentz-Richardson Company, Limited, 11 Phoenix Block, Winnipeg, Manitoba, Western Canada Sales Agents.

A. H. Winter Joyner Limited, 76 Bay Street, Toronto, Ontario, Ontario Sales Agents.

Roper, Clarke & Company, Limited, Coristine Building, Montreal, Quebec, Eastern Canada Sales Agents.

Trade Publications

Glassware.—Three booklets issued by Gill & Company, Inc., Philadelphia, describing respectively Velva glassware, Inca glassware and Una glass globes and shades.

Helping the Woodworker.—Booklet issued by the Westinghouse Electric & Manufacturing Company, explaining how the woodworker may increase his production, decrease his costs and improve his quality by the application of electricity through electric motors.

Machine Tool Service.—Catalogue No. 3002-A. issued by the Westinghouse Electric & Manufacturing Company, illustrating and describing the application of their electric motors in machine tool service.

Electricity in Coal Mines.—Catalogue issued by the industrial and power department of the Westinghouse Electric and Manufacturing Company, describing the application of central station power, through Westinghouse equipment, to the coal mining industry.

Wiring Specialties.—Supplementary catalogue, issued by the Arrow Electric Company, of Hartford, describing their latest additions to their line of wiring specialties.

Motor Transportation.—Illustrated booklet issued by the General Vehicle Company, Long Island City, through the Canadian General Electric Company, illustrating and describing efficient motor transportation in G.V. electrics.

Theatre Dimmers.—Booklet issued by the Cutler-Hammer Manufacturing Company, Milwaukee, describing a number of installation views of theatre dimmers, including illustrations showing installations of ventilating fan regulators and d.c. and a.c. types of automatic starters for motor-driven pumps and blowers.

Air-Brake Equipment.—Bulletin No. 44565, issued by the Canadian General Electric Company, describing and illustrating variable release air-brake equipment.

Portable Voltmeter.—Bulletin No. 46018, issued by the Canadian General Electric Company, describing their type P-8 portable voltmeter.

Induction Motors—Bulletin No. 123 issued by Robbins & Myers, Springfield, Ohio, describing, with illustrations, type K polyphase induction motors.

Current News and Notes

Carlyle, Sask.

The town's electric light plant was set in operation for the first time on Saturday, October 31st. The hours of service will be from dusk to 12.30 and from 6 to 9 a.m.

Chatham, Ont.

A number of representative citizens recently journeyed to Windsor, Ont., to make a study of the lighting system in that town. It is understood that the Windsor lights created a very favorable impression and that Chatham's new system, if it goes through, will be similar.

Delaware, Ont.

The Village Council is planning to install a lighting system and also equipment for distributing power to various consumers.

Edmonton, Alta.

Application will be made at the next session of the local legislature for an act incorporating the Edmonton North Western Radial Railway Company with power to construct and operate a railway or tramway by power other than steam from Edmonton in a north-westerly direction to a point at or near the Pembina River.

Fergus, Ont.

Hydro power was turned on in Fergus on Friday, October 23rd.

Flesherton, Ont.

The electors carried a by-law to expend $5,500 on an electric distribution system.

Galt, Ont.

The by-law authorizing the expenditure of $5,500 in additions to the water works system carried.

Guelph, Ont.

Contracts have just been closed for the supply of blocks of 40 and 50 h.p. to the Canadian Metal Products, Limited, and the Guelph Lumber Company, respectively.

Kamloops, B.C.

Work on the hydro-electric plant, which will supply the city of Kamloops with light and power, is making steady progress. It is expected that the plant will be in operation very shortly.

Kingston, Ont.

Kingston township ratepayers will vote on January 1st to grant a 30-year franchise to Mr. J. M. Campbell for the supply of electric power. It is understood a number of the farmers in the township are eager to install equipment for power and light.

London, Ont.

City Solicitor Meredith has been authorized by the Board of Control to make application in the city's behalf to the Dominion Railway Board for power to order that all telephone, telegraph and distributing electric wires be placed underground.

Montreal, Que.

The contract for the construction of underground conduits in St. Lawrence Street from Notre Dame to the river frontage has been awarded to Mr. G. M. Gest. The understanding is that Mr. Gest will employ only Montreal workmen and, as far as possible, married men will be given first choice.

The Montreal Council have passed a by-law allowing the Montreal and Southern Counties Railway Company to extend their tracks across McGill Street to Youville Square, with the object of extending the terminals. The city stipulate that it will take no legal responsibility, this clause being inserted in view of the contract of the City with the tramways company, whose lines run along McGill Street. The work is to be commenced before the 1st of January and completed in six months.

Owing to the giving way of the cofferdam at the head of the canal at the plant of the Cedars Rapids Manufacturing and Power Company, the water has been turned in sooner than was expected. It had been anticipated that the water would be in early in November, but on Friday, October 30, the barrier gradually gave way, owing to natural causes, and to a certain extent upset the plans of the engineers. Fortunately, preparations had been made almost completed for the admittance of the water. The excavation material carried into the canal will be removed by dredging.

The City Council of Maisonneuve, P.Q., have passed a resolution protesting against the nuisance caused by locomotives within the city, and requesting the Railway Commission to order the use of electric locomotives by the companies whose lines run through the city.

During the fiscal year ended June 30 the Montreal and Southern Counties Railway carried 1,915,379 passengers, an increase of 254,134 over the corresponding twelve months, 1913. The company has completed the fifth year of its existence.

Further steps have been taken by the Montreal Board of Control with a view to the city undertaking the work of electrical inspection now being carried out by a department of the Canadian Fire Underwriters' Association. The question has been referred to the Legislation Committee of the Council.

The General Railway Signal Company of Canada, Limited, Montreal, have transferred their executive offices from Lachine to 625 Transportation Building, Montreal.

New regulations governing the construction and erection of electric signs have been adopted by the Montreal Council. The by-law forbids the illumination of signs except by means of electric bulbs forming each letter or figure of the advertisement. The by-law applies to signs hanging more than six inches from the buildings to which they are attached, and which have been erected previous to the passage of the by-law. The signs must not protrude more than six feet from the buildings. The space to be illuminated is fixed at not less than 75 per cent. of the total area. Before permission is given to erect a sign a certificate must be submitted to the effect that the electric wiring of the sign and the arrangement of its electrical fixtures are in accordance with the rules and regulations of the Canadian Fire Underwriters' Association.

Mr. R. A. Ross, consulting electrical engineer of Montreal, will represent the City of Peterborough, Ont., in the public arbitration for taking over by the city of the plant of the Peterborough Light and Power Company.

The Canadian Underwriters' Electrical Inspection Bureau Limited, Montreal, has been incorporated with a capital of $25,000. The company's charter covers a wide area, but the chief business will be the inspection of electrical work, appliances and installations, which has hitherto been carried out by the electrical department of the Canadian Fire Underwriters' Association. Mr. C. M. Tait, the chief electrical inspector, is one of the incorporators of the

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at two cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Prince Rupert, B.C.

Applications will be received by the undersigned up to November 30th, 5 p.m., for the positions of chief and three shift operators for hydro-electric plant. Applicants must be thoroughly familiar with both water and electrical end of the business. Experience and salary required to be stated and copies of references sent

E. A. WOODS,
City Clerk.

22

Electric Generator

Wanted—A good second-hand generator capable of supplying 250 to 300 lights. Must be in first class condition. Quotations also received on new generator of same capacity. Clarke Bros., Bear River, N.S. 21-22

Sales Engineers Wanted

A large firm specializing in the manufacture of motors of all classes desires to secure sales engineers in various parts of Canada. Firms who can carry a stock of motors are preferred. Write stating the territory that you can cover. Box 96, Electrical News, Toronto. 21-24

Agents Wanted

Large firm making a complete line of electric centrifugal pumps; automatic electric compression water systems; electrically driven multi-stage turbine pumps; electrically driven double acting pumps and a number of other lines, want sales agents for various parts of Canada. Write stating what territory you can handle. Apply Box 94, Electrical News, Toronto. 21-23

Agents Wanted

Large firm making low voltage transformers and electrical measuring instruments wants sales agents for Canada. These transformers are for sign lighting, bell ringing, and toy requirements. The electrical measuring instruments include a complete line of switchboard and portable Ammeters and Voltmeters. All agents to work on a commission basis. Write stating what territory you can handle. Box 93, Electrical News, Toronto. 21-23

Lighting Schedule for December, 1914

Courtesy of the National Carbon Company, Cleveland

Date.	Light.	Date.	Extinguish.	No. of Hours
Dec. 1	No Light	Dec. 1	No Light	
2	No Light	2	No Light	
3	No Light	3	No Light	
4	5 00	4	7 20	2 20
5	5 00	5	8 30	3 30
6	5 00	6	9 30	4 30
7	5 00	7	10 40	5 40
8	5 00	8	11 50	6 50
9	5 00	10	1 00	8 00
10	5 00	11	2 10	9 10
11	5 00	12	3 20	10 20
12	5 00	13	4 30	11 30
13	5 00	14	5 50	12 50
14	5 00	15	6 40	13 40
15	5 00	16	6 40	13 40
16	5 00	17	6 40	13 40
17	5 00	18	6 40	13 40
18	5 00	19	6 40	13 40
19	5 00	20	6 40	13 40
20	5 00	21	6 40	13 40
21	5 00	22	6 40	13 40
22	5 00	23	6 40	13 40
23	10 30	24	6 40	8 10
24	11 30	25	6 40	7 10
26	0 30	26	6 40	6 10
27	1 30	27	6 40	5 10
28	2 30	28	6 40	4 10
29	3 30	29	6 40	3 10
30	4 30	31	6 40	2 10
31	No Light	Jan. 1	No Light	

Total Hours............233.50

new company, which will be affiliated with the Underwriters' Association.

The Montreal Electrical Society opened its winter session on Monday, November 2, when Professor A. M. Gray spoke on "Power Factor." The meeting was held in the Engineering Building, McGill University, the free use of which has been granted by the University for the entire session. The meetings will be held on the first Mondays in the month.

Newmarket, Ont.

At a special meeting of the Town Council a resolution was passed requesting the Hydro-electric Power Commission of Ontario to submit an estimate for the supply of current to the municipality.

Niagara Falls, Ont.

It is understood that the Electric Light Committee will call for tenders for the installation of a new lighting system. A representative committee recently visited Hamilton, and the new Niagara Falls system will probably be fashioned along similar lines.

North Toronto, Ont.

At a public meeting recently held in this town, the suggestion was made that the Hydro-electric Power Commission should buy out the Metropolitan division of the Toronto & York Radial Railway System. A committee will wait on the Toronto Board of Control to urge the construction of a municipal railway through Mount Pleasant Cemetery north and south, connecting at the south end with the St. Clair Avenue car line.

Oakwood, Ont.

Residents in the district between Mulberry and Kennedy Avenues have recently been supplied with house lights by the Toronto Electric Light Company.

Orillia, Ont.

Owing to dredging operations at present going on, water in the Severn river is very low, and at certain hours of the day insufficient to carry the load demanded of the plants at the Big Chute and the Ragged Rapids. Up to November 1st water in a number of Ontario rivers was unusually low.

Ottawa, Ont.

Application will be made to the Dominion Parliament at its next session by the Brantford and Hamilton Electric Railway Company for an extension of time within which the company may commence and complete certain of their lines.

Notice is given in the Canada Gazette that the corporate name of "Electrical Properties Limited" has been changed to "Western Electric Company, Limited."

Owen Sound, Ont.

Mr. Joseph McLinden, superintendent of the electric light plant, has made the suggestion that, when Eugenia power is brought to Owen Sound and the present steam plant will be needed only for emergency purposes, this plant might be used permanently in connection with a central steam heating system.

Regina, Sask.

The operation returns of the Regina Municipal Railway System for the week ending October 31st, were:—Revenue, $2,819.80; passengers carried, 70,334.

The Telephone Department of the Saskatchewan government has just issued a report covering the fiscal year ending April 30th, 1914. During the year a total of 251 applications for the incorporation of rural telephone companies were received, of which 140 were approved. There are now in Saskatchewan 368 private telephone systems.

Telephone communication between Saskatchewan and Alberta has now been made possible by the completion of a long distance telephone line from Gull Lake, Sask., to the Alberta boundary, where it connects with the Alberta system.

Shelburne, Ont.

At a recent meeting of the ratepayers, it was unanimously decided to submit the question of getting a supply of electric power from the Hydro-electric Power Commission of Ontario at an early date.

Simcoe, Ont.

A contract has been awarded for the erection of the new hydro-electric sub-station. Work on the distribution system is already under way.

St. John, N.B.

The St. John Board of Trade has taken the initiative in a movement for a British-owned cable between the Dominion and the Mother-land. The prevailing feeling in Canada today is that national and commercial considerations urgently demand a State-owned cable, if not a State-owned telegraph system. Such cable communication, while tending to cement still firmer the bond between Britain and her overseas Dominion, would also be of great advantage commercially, not only to Britain and to Canada, but to the British possessions in the Pacific that are now connected by cable with this country. Some years ago, Sir Sandford Fleming, the distinguished Canadian engineer, tried to awaken an interest in a British-controlled cable, but he did not succeed. Canadians today see their national interests more clearly, and a State-owned cable has become imperative.

St. Thomas, Ont.

The Western Ontario Electric Company, Limited, contractors and dealers in electrical supplies, 380 Talbot Street, St. Thomas, has made an assignment.

Tillsonburg, Ont.

The unused electric plant of Barkey Brothers at Tillsonburg was recently destroyed by fire.

Toronto, Ont.

Work has commenced on the construction of the Bloor Street West civic car line.

The Ninth Annual Convention of the Canadian Independent Telephone Association was held in Toronto on Wednesday and Thursday, November 11th and 12th.

The report which was more or less widely quoted some time ago, that the Ontario government was allowing the export of power to Detroit, has been denied. It is true that negotiations were carried on at one time, but these fell through many months ago, and it is very unlikely that the matter will come up again.

The firm of Chapman & Walker, Richmond Street West, electrical contractors and supplies, has assigned.

The Hydro-electric Power Commission of Ontario have decided to amend their rules and regulations on inside wiring by the addition of a new clause to be known as Clause E, at the end of knob and tube wiring, page 65, which will read as follows:—"Flexible conduit must be securely held in place where entering switch or outlet boxes by an approved fitting or device."

By a recent order of the Ontario Railway and Municipal Board, the Toronto Railway Company is required to place 50 more new cars in service before June 1st, 1915. They are also required to reconstruct 13½ miles of track, to have the Terauley Street line operating to College Street by December 1st, 1914, to extend their tracks in the Ossington Avenue district to Lansdowne Avenue, and to report to the board before January, 1915, on the cost of an improved heating sstem for the cars. In refusing the city a number of their demands it is pointed out by the board that the earnings of the company have dropped off considerably during the past summer, and also that the franchise has only some seven years to run.

Woodstock, Ont.

The Woodstock Water and Light Commission have voted $500 to the Oxford Patriotic Fund, and $500 to the Belgian Relief Fund.

Electrical News
Generation, Transmission and Application of Electricity

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NEW YORK - Tel. 3108 Beekman - 628 Tribune Building
CHICAGO - Tel. Central 6403 - 1155 Peoples Gas Building
LONDON, ENG. - - - - - - - - 3 Regent St. S.W.

ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.
Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

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Vol. 23 Toronto, December 1, 1914 No. 23

Human Conservation

This is an age of conservation—conservation of natural resources,—minerals, water powers, forests, and so on,—conservation, no less, of the resources of our citizens, the maintaining of all their faculties, both of mind and body, in a state of highest efficiency and constant readiness for service. As in medical science, so in every line of commerce, this is an age of prevention rather than cure, of foresight in avoiding delays rather than in hurrying to overtake them, of caution in eliminating mistakes rather than in willingness to correct them—all of which means that we are earnestly seeking for any and every development of modern science which will help to make and keep the human machine in its highest state of efficiency, ready to turn out a maximum of product of the best possible quality. This is equally true of every class of workman, whether his work is mechanical or mental, or a combination of both.

It is failure to appreciate these changed conditions and the tremendous possibilities of this new order of things, that accounts for so many big employers of labor still contenting themselves with under-efficiency in both equipment and men. They will invest money in anything but "efficiency"—largely, no doubt, because efficiency has not been capitalized, distributed in the form of gilt-edged certificates, listed on the stock exchange, or made the excuse for promises of big dividends. Yet, as a matter of fact, an investment in "efficiency" equipment will yield bigger returns than any other investment. It has never yet "passed" a dividend. Profits are surer in years of depression than in good times; surer in war than in peace. Efficiency welcomes competition, new conditions, added responsibilities. Human faculties, thoroughly trained and properly conserved, are strengthened with every obstacle met and overcome.

But it must be remembered that efficiency in the human being means both the condition within the man himself and the conditions surrounding him. A first-class workman operating under unfavorable conditions is no better than a poor workman operating in favorable surroundings,—neither will turn out a first-quality product. Many employers of labor pay big wages to skilled men and then hamper their work with poor machinery, poor tools, poor heating and ventilation—poor lighting. Each of these items plays a most important part in the day's work, but especially we are anxious to draw the attention of employers to the value of good lighting in office, warehouse or factory, because—possibly to a greater degree than any of the others—good lighting adds tremendously to the efficiency of your plant in three distinct ways:

(1) Quality: There are few mechanical operations that cannot be performed better by good daylight than by artificial. It follows that the nearer to daylight your artificial lighting can be made, the better quality work your men can turn out. With the most approved methods of installation, supplemented by the proper lighting units, a very near approach to this condition can now be obtained, and should be insisted on wherever a number of men are employed. The condition of the workman is also a very important factor in the quality of his work, as it is now an accepted physiological fact that poor lighting reduces both the capacity and the inclination of the individual to produce results.

(2) Quantity: Unsatisfactory conditions of working spell delay, and delay means reduced consumption. It is important that the workman should be producing every minute of the day. Suppose poor lighting causes him to go to the window for the closer inspection of his work, to hesitate in some mechanical operation for safety's sake, to rest his eye owing to unnecessary tension, or to become tired before his day's work is done, then the quantity of work is less than he could turn out under more favorable conditions. If a man is paid, say, $5 a day of eight hours or practically one cent a minute, he does not need to lose many minutes every day before he has lost for his employer more than the original cost of a correct lighting installation.

(3) Safety: Correct illumination is the best and cheapest form of industrial insurance. It has been shown that, averaging a large number of typical factories, the number of accidents was formerly inversely proportional to the number of hours of daylight. Quite aside from humanitarian considerations, then, a poorly lighted factory is an expensive system for any considerable employer of labor to maintain. Under improved lighting conditions, as we can produce them today, this state of affairs is being largely overcome. Factory managers are beginning to realize that a single accident avoided will well repay them for the rehabilitation of their whole system.

Sub-Station Exterior Design

In previous issues we have called the attention of our readers to the big possibilities of improvement in the appearance of power-houses, sub-stations, etc., all over Canada. The addition of a little beauty in design adds a comparatively insignificant amount, often nothing, to the cost of a building, and there is gained the distinct educative value of this constant reminder of the pleasurable effects of simplicity and correct proportion.

It is quite time we should get away from the idea that any old building will do for an electric power house or substation; for commercial reasons alone, if there were no others, this is true. We want to impress the public with the idea (the correct one) that the use of electricity means added cleanliness, neatness and beauty in our homes. The

ordinary power-house suggests none of these things. It should suggest all.

The Hydro-electric Power Commission of Ontario have it in their power to vastly improve the standard of design of electric buildings in the province at least, and indirectly all over the Dominion. That they have kept this feature in mind is evident from the very prepossessing buildings they have erected throughout the districts served. A typical smaller sub-station is shown herewith. This represents an inexpensive building, the Streetsville sub-station, built for

Typical sub-station of H. E. P Commission of Ontario.

$800 or $900, and of sufficient capacity to accommodate three 200 kv.a. transformers, 13,200 volt switching and protective apparatus, and three or four panel switchboards. Most of these structures built by the Commission are of pressed brick. It is the good lines in the design of these buildings that adds most to their effectiveness, however. Their simplicity and solidarity also suggest power. With a little attention to the surroundings, such buildings are a source of pleasure, pride and education to the community.

Inspection Department Report

The Department of Inland Revenue for the Dominion of Canada has just issued its annual report for the year ending March 31st, 1914, dealing with weights and measures, gas and electricity. It is pointed out in the introduction that the two services of gas and electricity inspection, which are conducted largely by the same staff of officers, have, since 1896, ceased to be a burden upon the general taxpayer. For the twelve months covered by the report, the gross revenue was $143,386, as against $13,014.

A certain reduction of the fees in connection with both gas and electricity inspection was made in 1909 and 1911, but the report hints that, inasmuch as this has not yet brought about an equilibrium between receipts and expenditures, a further reduction will be made.

The revenue derived from the section of electricity alone for the year ending March 31st, 1914, was as follows:

Fees for inspection of meters, etc.		$80,476.50
The expenses of inspection (annual) ...	$39,347.02	
Expended on standard instruments, and maintenance of equipment	10,788.27	
		50,135.29
Leaving a net revenue of		$30,341.21

On the supposition that the amount expended on instruments and equipment maintenance is normal, it would appear that a considerable reduction in fees is possible. It must not be overlooked, however, that this work of standardization requires instruments of highest possible quality, which are very expensive. It is open to question whether the department is any too well equipped for the important work

Table I.

Districts.	Presented for Verification.	Verified as coming within the error tolerated by law.			Rejected.			Verified after first Rejection.			Totals.	
		Correct.	Fast.	Slow.	Unsound.	Fast.	Slow.	Correct.	Fast.	Slow.	Verified.	Rejected.
Belleville	2,753	995	1,312	442	...	3	1	...	...	...	2,749	4
Fort William	3,937	1,332	1,311	1,264	...	12	18	...	...	...	3,907	30
Hamilton	12,428	8,855	1,231	2,341	...	...	1	...	...	...	12,427	1
London	7,696	2,798	2,820	2,069	...	6	4	...	...	...	7,687	9
Ottawa	8,108	1,369	4,199	2,506	9	7	18	...	...	...	8,074	34
Toronto	23,829	13,238	7,178	3,405	...	1	7	...	...	...	23,821	8
Montreal	20,486	18,242	1,701	539	...	3	1	...	...	...	20,482	4
Quebec	2,263	1,232	601	430	...	...	...	...	...	...	2,263	
Sherbrooke	941	375	238	328	...	...	...	...	...	...	941	
St. Hyacinthe	1,157	305	655	192	...	3	2	...	...	...	1,152	5
Three Rivers	157	136	16	5	...	...	...	...	...	...	157	
St. John	2,210	1,008	662	629	5	2	3	1	...	...	2,199	11
Halifax	3,032	1,984	464	639	36	3	6	...	...	...	2,987	45
Charlottetown	490	178	71	226	...	1	14	...	...	...	476	15
Winnipeg	11,014	2,916	7,355	733	...	1	9	...	...	...	11,004	10
Regina	5,325	1,830	2,167	1,320	3	3	2	...	...	...	5,317	8
Calgary	3,706	1,347	1,976	371	...	8	4	...	...	...	3,694	12
Edmonton	5,143	1,709	2,938	472	1	13	10	...	...	...	5,119	24
Vancouver	9,845	2,861	6,838	1,122	...	4	...	...	...	...	9,841	4
Victoria	4,175	2,152	1,085	938	...	...	...	...	...	...	4,175	
Totals	128,695	64,882	43,818	19,771	54	69	100	1	...	...	128,471	224

to be performed. The total number of meters presented for verification during the period covered by this report was 128,695. Of this number 224 were finally rejected. It is interesting to note that of those verified as coming within the error tolerated by law, 43,818 were fast as against 19,771 that were slow. Only 54 meters out of this number were rejected as unsound.

A very interesting section of the report is given over to the quantity of power produced in Canada by companies operating at or near the border line, and which generate power both for consumption in Canada and for export to the United States. The total amount produced for export is almost exactly the same as that produced for home consumption, being a little over 770,000,000 kw.h. in each case. Of the seven companies at present manufacturing for export, three export considerably more than half of their product; these are the Canadian Niagara Power Company, which exports 400,000,000, as compared with a home consumption of 11,000,000 kw.h. The Ontario and Minnesota Power Company at Fort Francis, which exports nearly 22,000,000 as against less than 1,000,000 kw.h. consumed in Canada, and

Table II.

—	Units Produced for Export.		Units Produced for use in Canada.		Total Output of Generating Station or other Source.	
	K. W. Hours.	H. P. Years.	K. W. Hours.	H. P. Years.	K. W. Hours.	H. P. Years.
Ontario Power Co.	282,123,004	43,168·36	412,597,896	63,137·1	694,720,900	106,305·46
Canadian Niagara Power Co.	400,214,980	61,241·15	11,420,020	1,747·53	411,635,000	62,938·68
Electrical Development Co.	42,154,000	6,413·53	191,885,670	29,356·78	234,039,670	35,800·31
‡International Railway Co.	......	......	......	......	......	......
‡Electric Distributing Co.	......	......	......	......	......	......
Ontario and Minnesota Power Co.	21,649,327	3,306·60	868,856	132·95	22,518,183	3,439·55
Maine & New Brunswick Electric Power Co.	2,846,018	435·49	57,967	7·87	2,903,983	441·36
‡Cedar Rapids Power and Manufacturing Co.	......	......	......	......	......	......
‡Sherbrooke Railway and Power Co.	......	......	......	......	......	......
British Columbia Electric Railway Co.	395,831	60·58	114,697,400	17,611·56	115,093,231	17,612·14
Western Canada Power Co.	23,213,891	552·28	39,339,239	6,019·83	62,553,130	9,572·1
Totals	772,597,049	118,207·99	770,867,048	117,955·62	1,543,464,097	236,162·61

‡ These companies have not yet commenced to export

the Maine and New Brunswick Electric Power Company, which exports nearly 3,000,000 kw.h., to a home consumption of 58,000. The complete list of production, export and home consumption is given in one of the accompanying tables.

The Dominion Government have refused the application of the city of Halifax for disallowance of an act passed at the last session of the Nova Scotia legislature and known as the Act to Incorporate the Nova Scotia Tramway & Power Company, Limited. The company has a capital of $6,000,000 with power to increase to $10,000,000.

Letters to the Editor

Editor, Electrical News,
Toronto, Ont.

Dear Sir,—

We notice on page No. 43 of your November 15th edition of the Electrical News an interesting article on testing instruments manufactured by the Weston Electrical Instrument Company.

We desire to correct a mis-statement at the end of this article which says:

"That these instruments are for sale by the Northern Electrical Company, Limited, who are the Canadian Agents for the Weston Electrical Instrument Company."

The Northern Electric Company are not the Canadian Agents for the Weston Electrical Instrument Company, although we believe they represent them in some districts in Canada. We also wish to state that we are the Ontario Agents for the Weston Electrical Instrument Company. We have been the Ontario Agents for them since the writer started business, and any information which implies that the Northern Electric Company, Limited, are the Canadian Agents is a direct misrepresentation of the facts.

We trust that you will give this letter space in your valued journal. We are,

Yours very truly,
A. H. Winter Joyner Limited.

Toronto, Ont., Nov. 21st, 1914.

Grounding Secondaries

The following letter from the city of Winnipeg's city electrician, is one more testimony to the recognized value, and the consequent urgency, of grounding the secondaries of low voltage distributing systems.

Mr. Cambridge is none too emphatic in his statement that "it will undoubtedly eliminate fatal accidents such as alluded to." It is gratifying to note the determined stand taken by the Manitoba Public Utilities Commissioner, Mr. H. A. Robson. Mr. Cambridge's letter, and Mr. Robson's order in this matter are both reproduced below.

Mr. Cambridge's Letter

Editor, Electrical News,
Toronto, Ont.

Dear Sir:

I have read with much interest your editorial remarks on the question of grounding of secondaries of a.c. systems.

Thinking it may be of interest to your readers, I enclose copy of Order of the Public Utility Commission of this province, calling for the grounding of all low voltage secondary systems in this city. This work is now proceeding. A very great saving is being reached in the matter of cost by the two competing interests using ground connections in common, where feasible. All grounds are made to city hydrants through a special lug into which the ground wire is brazed, the lug being attached under one of the hydrant bolts. No joints are attached in the wire underground and the wire is not allowed to cross a street owing to the danger of it being interfered with. To cover the two distributing systems in a city of this size with a protective system of this kind will take some time and will certainly cost a considerable amount, but I am satisfied the outlay will be thoroughly justified, as it will undoubtedly eliminate fatal accidents such as alluded to by you and which we have also experienced here.

Yours very truly,
F. A. Cambridge,
City Electrician.

Winnipeg, November 21, 1914.

Mr. Robson's Order
In the Matter of the Grounding of Transformer Secondaries

Upon the Commissioner's initiative and upon hearing various persons interested, including representatives of the city of Winnipeg (Light & Power Department), the Winnipeg Electric Railway Company, and Mr. T. J. Murray and Mr. J. B. Pegg, representing the workmen engaged on electrical line work, it is ordered:

1. That the said city of Winnipeg (Light and Power Department) and the Winnipeg Electric Railway Company do in all cases ground its transformer secondaries of distribution system where the potential of such circuits does not exceed two hundred and fifty volts, and the following directions shall be observed:

> All ground connections must be made at the poles where individual transformers are installed, and not within the building of the consumer, unless by special authority of the City Electrician in writing, nor shall the service switch on either the consumer's side or the service side be connected to the ground. Secondary circuits over 1,000 feet long must have one ground for each 1,000 feet or fraction thereof.
>
> In the case of underground distributing systems the grounds must be made to the water mains in the case of individual transformers. In the case of secondary mains supplying a number of customers ground connections shall be made to the water mains, either 1,000 feet apart, or to a continuous ground wire of ample conductivity, connected in the same manner.
>
> The ground connection is to be made wherever possible by connecting to the city's water mains with a wire of suitable size, but in no case less than No. 6 B & S gauge, so that the total resistance from the point of connection to the service to the water pipe will be less than one-half of one ohm. Care must be taken in making connection to water pipe to insure a perfect mechanical and electrical connection.
>
> All single phase, two wire secondary circuits are required to be connected to ground on one side of the circuit, and all three wire circuits to be grounded at the neutral wire. All multiphase secondary circuits must be grounded from the neutral point of the phase connections, provided the maximum difference of potential between the grounded point and any other point in the circuit does not exceed 150 volts.
>
> In cases where owing to the inaccessibility of a water main or pipe it is impracticable without extraordinary expense to ground thereto, the City Electrician may designate another manner suitable to him in which the grounding may be affected.
>
> All work to be done under this order shall be subject to the supervision of the City Engineer, whose permission is to be obtained, and who is to be notified at least forty-eight hours before the proposed work is commenced.
>
> Existing regulations as to opening of the ground of any street or lane are to be observed.
>
> Each of the parties affected hereby shall give written notice to the City Electrician of all work done by them towards compliance with this order.

2. That the said Winnipeg Electric Railway Company, and the City of Winnipeg (Light & Power Department) do proceed with all practicable diligence to ground in manner aforesaid transformer secondaries in existing installations so as fully to complete such grounding not later than January 1st, 1915, or such later period as may be ordered in the event of diligence meanwhile being shown.

3. This order will be effective on this date (April 12, 1914) in the public interest.

(Signed) H. A. Robson,
Commissioner.

Montreal Arena's Ice Plant

The Montreal Arena Company have just installed a plant for producing manufactured ice for commercial purposes and for an ice skating surface. The plant, housed in a separate two-storey building on St. Catherine Street, is operated by electric current supplied by the Montreal Light, Heat and Power Company. The refrigerating machines, made by the Canadian de La Vergne Limited, are belt driven by two 80 h.p., 3 phase, 497 r.p.m., 2200 volt, slip-ring motors manufactured by the Triumph Electric Company, of Cincinnati, speed control equipment being of the Cutler-Hammer drum type. The ice tank for making commercial ice is operated by a 550 volt Triumph squirrel cage motor, driving by belt an agitator in the brine tank, the ice being taken out with a crane fitted with a 2 h.p. electric hoist. A small circulating pump direct connected to a 2 h.p. squirrel cage motor circulates the purified water to be made into commercial ice of 400 pound blocks.

In connection with the refrigerating machinery, tandem air compressors (Canadian Ingersoll Rand make) are installed, these having high and low pressure cylinders independent of each other; the high pressure side pumps an artesian well and the low pressure furnishes air for the agitator of the commercial ice making tank. For the circulation of brine for the skating rink floor, two 7½ h.p., 3 phase, 550 volt Triumph slip-ring motors are direct connected to centrifugal pumps. These motors have Cutler-Hammer controls. A ½ h.p. Triumph motor is direct connected to a centrifugal pump for circulating water to the spray pond for cooling purposes.

The Montread Light, Heat and Power Company supplies two services at 2200 volts, the services being transformed by three 15 kw. Packard Electric Company, Limited, transformers, to 550 volt for power purposes for the small motors, and 110 volt for lighting. A panel board, made by the Monarch Electric Company, St. Lambert, P.Q., is fitted with a double throw switch, one side operating a 5 h.p. Wagner motor which drives a compressor to be used as a stand-by for the agitator in case of interruption to the current; the other side of the switch operates the other line of motors. The switchboard is also fitted with a voltmeter, two ammeters connected to the 80 h.p. motors, two oil switches with no-volt and overload releases for the operation of the 80 h.p. motors, and a 10 volt lighting switch. The wiring contract was carried out by the Century Electric Company, Montreal, who also supplied the switches. Mr. H. R. Drackett is the engineer responsible for the design and installation of the plant, with Mr. J. Bennett as consulting engineer. Most of the electrical equipment was supplied by the Rudel-Belnap Machinery Company, Limited, Montreal.

Electrical Equipment of Mountain Park Coal Co.

The Mountain Park Coal Company, situated 220 miles south-west of Edmonton on the G. T. P. Railway has plans that, when fully developed, will give an output of 2,500 tons a day. At the present time, on a four-day working schedule per week and with a reduced gang, the company are getting out approximately 250 tons. The mining rights include 369 square miles in the immediate vicinity of their present plant.

This mine, though still in its infancy, is operated altogether by electricity. The power-house is located in the centre of the three drift shafts at present in operation, and contains the following equipment.—Three Robb horizontal tubular boilers, 150 h.p. each, working at 125 pounds pressure; one Robb high speed horizontal engine, 125 h.p., belt connected to a 100 kw Century d.c., 220-volt generator; one [illegible]00 h.p. Robb high speed horizontal engine, belt connected to a Westinghouse 325 kw., 220-volt generator. The switchboard consists of a three-panel slate having one large ammeter and voltmeter together with the necessary switches.

There are two fan-houses located near the mining shafts. The fans were supplied by Sheldons' Limited, Galt, Ont., and are driven by Westinghouse 20 h.p., 220-volt, d.c. motors.

The company advise that the use of d.c. equipment allows of a more flexible arrangement for controlling the motor speeds but it has the disadvantage of a fluctuating voltage which is quite noticeable on the lighting circuits.

When this mine is fully developed, it will, according to present expectations, be one of the most modern in western Canada. The present generating station will then give place to much larger units and the whole plant will be rebuilt according to the most approved specifications as soon as the increasing business warrants the expenditure.

Coronation Now Electric Lighted

The town of Coronation, Alta., inaugurated its new system of electric lighting and water works on October 15th. The Canadian Pacific Railway Company operated its first train into Coronation on September 15th, 1912, and to-day this village of yesterday has a population of over 800 and is doing a thriving business, as it is the centre of a good agricultural community. It is certainly indicative of the progressiveness of the citizens that they should have installed an up-to-date electric light plant. The equipment consists of two Watrous return tubular horizontal boilers of 100 h.p. each, a McEwan engine, 14 by 14, 227 r.p.m., horizontal type, direct connected to a Westinghouse 75 kw., 2,300 volt, 60-cycle, three-phase generator. The switchboard is a one panel, Vermont marble, fitted with a Westinghouse meter, a voltmeter and recording wattmeter. There is also one arc light panel and one constant current transformer supplied by the Canadian General Electric Company. The town is at present installing an ornamental street lighting system, using 5-light Park-way standards of an attractive design.

The water pumping equipment is also situated in the power house and consists of one deep well steam pump and one high pressure fire underwriters' pump manufactured by the Canada Foundry Company. The municipality have built a large service reservoir together with a 20,000-gallon tank supported on steel structure 100 ft. above the ground.

Guelph Gets Low Rates

New rates go into effect in Guelph on January 1st, 1915, similar to those recently announced for Galt. The domestic lighting rate will be 3c per 100 sq. ft. for a minimum floor space of 1,000 ft. and a maximum of 3,000, with an additional meter rate of 2½c per kw.h.; 10 per cent. discount is given off the total value for prompt payment. For commercial lighting the rate is 6c per kw.h. for the first 30 hours' use of installed capacity and 2½c per kw.h. for all in excess of this amount; 10 per cent. discount. The power rate is $1 per h.p. plus 2c per kw.h. meter rate for the first 50 hours' use of installed capacity, 1½c for the second 50 hours and .2c for the balance; a discount of 25 per cent. and 10 per cent. is allowed on the power bills. The street lighting has been reduced from $9 per lamp of 100 watt capacity to $8.50 per lamp, per year.

In order to have a reserve supply of power in case the supply now drawn from the municipal plant gives out, the Ottawa Waterworks Department has contracted with the Ottawa Electric Company for an additional transmission line to be connected with the pumping plant at Lemieux Island. The Department recently advertised for four centrifugal, direct connected, 15-million gallon pumps, each to be driven by a 50 h.p. motor.

Making Our Water Powers Valuable

A Discussion of the Further Uses to Which Our Water Powers Might be Put—Huge Requirements of Industrials—Some Interesting Comparative Figures

By Arthur Surveyer*

The utilization of the slope of rivers for power purposes is as old as history, but the harnessing of the larger and higher water falls has been a modern victory achieved in the last fifty years.

The chief factors in this conquest were the superseding of the old current wheel by the modern turbine developed by Fourneyron and Francis, and the discovery of the application of electricity.

In this connection a few words may not be amiss. Between 1840 and 1850, the two French engineers, Fourneyron and Girard, both utilized water falls of over 325 feet in height to operate their turbines. These trials were not, however, entirely successful and it was only in 1869 that another French engineer, Aristide Berges, succeeded in operating steadily a turbine under a head of over 650 feet. This wheel was connected to the wood pulp grinders of a paper factory situated at Lancey. Because of the success of his first venture, Berges erected in 1873 another turbine, this time under a head of 1,640 feet.

Towards 1880 the Belgian electrician Gramme announced the development of his alternator, which was to be subsequently improved by Kapp and Westinghouse. Just at that time, or to be more accurate, from 1880 to 1883, the French engineer Marcel Deprez conducted some very important experiments on the transmission of electricity, on a line eight miles in length running between the town of Vizille and the city of Grenoble.

This was followed by the invention of the transformer in England by Gaulard and Gibbs in 1882, and of the automatic turbine governor by Piccard in 1885.

Previous to these dates energy had been transmitted by cables at Schaffhausen and at Fribourg, and by water under pressure at Geneva and Zurich.

These component parts of the modern hydro-electric plant were first assembled into a working whole at Lauffen, in Germany, in 1891. The energy was generated at 50 volts, then stepped up to 13,000 volts and transmitted to the Frankfort Exhibition, 75 miles away.

The first development in America was a 15,000 h.p. plant constructed at Niagara Falls in 1893. Since 1895 the technics of hydro-electric work has progressed wonderfully, and the recent improvements in insulation have made possible the economical transmission of energy for distances of two hundred miles and over, whilst the improvement in modern turbine construction has allowed of the commercial development of low heads which could not have been considered ten years ago.

The conflict now raging in Europe has practically called a halt to our industrial development, and it has struck the speaker that this marking time period is especially adapted for a review of past achievements and a survey of the work which may be done in the future.

Lately our economists, statesmen, and journalists have extolled our water powers and have been pleased to see in the number of our water falls the guarantee of our future industrial superiority. Without desiring to minimize in any way the importance of this national asset, it might be interesting to compare this wealth with the similar wealth of other countries and to examine whether or not we are making or are preparing to make the best possible use of it.

Table I. has been compiled from various European sources, from the reports of the United States Geological Survey and from the report of the Canadian Commission of Conservation. It shows the total available and the developed water powers in the different countries of Europe, in the United States, and in the various provinces of Canada; it also indicates the percentage of utilization for each country and the horse-power per square mile.

*Read before the Canadian Society Civil Engineers.

Table I.

	Hydraulic Power Available on Turbine Shafts Available	Developed	Per centage of Utiliz-ation	Available Power per Sq. Mile
EUROPE	h.p.	h.p.	%	h.p.
Great Britain	963,000	80,000	8.3	1.00
Germany	1,425,000	445,000	31.2	1.18
Switzerland	1,500,000	380,000	25.0	3.71
Spain	5,000,000	300,000	6.0	3.86
Italy	5,500,000	565,000	10.2	4.22
France	5,857,000	650,000	11.1	5.80
Austria-Hungary .	6,460,000	515,000	8.0	7.34
Sweden	6,750,000	550,000	8.2	7.72
Norway	7,500,000	920,000	12.3	14.12
	40,955,000	4,405,000	10.6	5.44
NORTH AMERICA				
United States	26,736,000	4,016,000	15.0	7.49
CANADA				
Saskatchewan	20,000	45	0.2	.19
Alberta	71,000	7,000	9.8	.69
Nova Scotia	83,000	15,000	18.0	3.93
New Brunswick ..	280,000	10,000	3.6	10.03
Manitoba	410,000	48,000	11.7	6.37
British Columbia .	1,100,000	101,000	10.1	2.81
Ontario	3,400,000	504,000	14.8	15.41
Quebec	5,600,000	328,000	5.8	16.38
North West Ter't's.	6,900,000	......	0.0	3.19
	17,764,000	1,013,045	8.2	6.55

The data contained in this table refer to conditions in the year 1911, and the provincial areas used to calculate the figures of the last column are taken from the Canadian Atlas of 1906.

It would have been more interesting if complete figures for 1914 were available. Unfortunately, nothing authentic could be obtained except in a few instances. The inclusion of the new Shawinigan development, the Canadian Light & Power Company's plant, and the large development at Cedars would raise the figures for the Province of Quebec to over 500,000 developed horse-power. Switzerland's present figures are about 550,000 h.p., Norway's over 1,000,000 h.p., and that of the United States between 5,500,000 and 6,000,000 h.p.

It is probable that the data concerning Europe and the United States are fairly accurate, whilst the Canadian figures are based on doubtful information. The Conservation Commission of Canada in its report of 1911 did not "consider advisable to make an estimate of the total water power in Canada," adding, "one estimate places it at nearly 17,000,000 h.p.; but it does not, and cannot, rest upon any basis of reliable information."

A careful study of this table will alter many of our preconceived ideas; we must realize that our country is not the wealthiest in water powers, especially if we compare our different provinces with countries of practically similar area, say France, Austria, Sweden and Norway. It is true that the

ticular time, Germany's high percentage, 31.2 per cent. utilized, and to observe that the next country on the list is Switzerland with 25 per cent., chiefly acquired through the investment of German money.

Tables II. and III. refer more closely to the subject and supplement to a great extent the information given in Table I.

Table II.

Provinces	Developed Power.	Subdivisions of Developed Power. Electrical Energy.	Pulp and Paper.	Various Industries
	h.p.	h.p.	h.p.	h.p.
Ontario	504,000	394,000	46,000	64,000
Quebec	328,000	198,000	88,000	42,000

Table II. has been compiled from the report of the Canadian Commission of Conservation and details the uses made of the developed water powers in Ontario and Quebec. It is to be noted that 74,000 electrical horse-power are exported from the Province of Ontario to the United States at Niagara Falls, and this amount is therefore not included in Table III.

Table III. indicates the uses made of the hydro-electric energy generated in Ontario, in Quebec, in France, in Sweden, and in Norway. The data for the provinces of Ontario and Quebec were taken from a paper by Mr. Watson Bain on the "Electro-Chemical Industries in Canada." The information for the other countries is the result of the compilation of statistics up to 1910. The conclusions resulting from the examination of Table III. are that up to the present we have only progressed in the more simple applications of electricity, and that we have practically neglected its utilization as an electrolytic agent and as a heat generating agent in electro-chemistry and electro-metallurgy.

Table III.

Countries	Developed Hydro-Electric Power.	Subdivision of Developed Power. Electro-Chemistry and Electric Metallurgy		Motor Power, Traction and Lighting.	
	h.p.	h.p.	%	h.p.	%
France	592,000	291,000	49.1	301,000	50.9
Norway.	543,000	275,000	50.6	268,000	49.4
Sweden	370,000	120,000	32.4	250,000	67.6
Ontario	320,000	25,000	7.8	295,000	92.2
Quebec	198,000	28,000	14.1	170,000	85.9

It would probably be easy to explain this one-sided development of our hydraulic powers, but the important thing now is the patient search for ways and means to enable us to alter these conditions.

It is self-evident that the consumption of electricity for lighting or for traction depends on population Neglecting the Montreal market, which is exceptional, the consumption of electricity per capita for either lighting or for traction is too small to be considered as an inducement to the extensive development of our water falls. A western statistician gives the consumption of electricity in small towns as roughly 1/10 of a horse power per inhabitant, so that a plant of 1,000 h.p. would, on this basis, be sufficient to supply the requirements of a town of 10,000 population. On the other hand, the smallest electro-chemical or electro-metallurgical industry consumes more than 1,000 h.p. Plants of 10,000 h.p. are numerous, and those of over 30,000 h.p. are by no means exceptional.

The pulp and paper industries are also great users of power, but we in Canada are not so very far behind in this phase of development, although Sweden utilizes over 120,000 h.p.

An improvement in the situation might be brought about by attracting to Canada more electro-chemical and electro-metallurgical industries, thereby causing a notable increase in the development of our water powers. It has been thought advantageous to briefly review some of the industries which, either on account of the abundance of the necessary raw materials, or because of the large neighboring markets, might be likely to prosper in Canada.

ELECTRO-CHEMISTRY

Calcium carbide.—Calcium carbide is obtained by causing quick-lime to react on coke at the temperature of the electric arc: its principal use is in the production of acetylene gas and more recently for the production of calcium cyanamide.

The industry of calcium carbide was started in 1895, with Mr. Wilson, of Ottawa, as one of the pioneers. There are now over seventy plants situated all over the world requiring 360,000 h.p. for their operation. The world's production for 1910 was 250,000 tons; it was 300,000 tons in 1912, and increased to 340,000 tons in 1913.

One special feature of the carbide industry is that many of the producing countries are not users of the product and that the centres of consumption are located in places where it is impossible for want of water falls to manufacture carbide. Consequently, calcium carbide is a travelling product, and about 50 per cent. of the production of the different plants is exported to other countries. Germany, England, Austria, and the South American Republics are the importing countries; the consumption of Germany has increased five-fold in the last fourteen years, having risen from 11,000 to 55,000 tons annually. The exporting countries are Sweden, Norway, Switzerland, and the United States. The production of the United States in 1913 was 70,000 tons, with an export trade of 15,000 tons. The American exports go to South and Central America, where the demand for acetylene for house lighting is rapidly increasing.

The manufacture of calcium carbide is the oldest of the electro-chemical industries in Canada. There are at present in operation three plants absorbing altogether 14,000 h.p., and producing every year about 12,000 tons, half of which is exported. The Thorold plant has been in operation since 1897, producing over 1,000 tons a year. The Ottawa plant supplies over 4,000 tons, and the Shawinigan Falls' works about 7,000 tons. These three plants have recently been amalgamated under the name of the "Canadian Carbide Company," with a capital of $2,000,000.

The nitrogenized products.—The study of the consumption of the azotized or nitrogenized products leads into the domain of the agricultural engineer, and necessitates a statement of the part played by nitrogen in the vegetable kingdom. Plants must have nitrogen to live. The leguminous plants and a few others only can borrow the nitrogen required for their existence from the atmospheric air. The great majority of vegetables are obliged to obtain the azotized compounds necessary to their life from the ground itself.

The principal nitrogenized fertilizers are manure, dried blood, wood wastes, horn, leather, nitrate of soda, sulphate of ammonia, calcium cyanamide, and nitrate of lime.

Nitrate of soda or Chili saltpeter is the best known of the imported fertilizers; it is found in its natural state in immense deposits situated in Chili, Peru, and Bolivia. The export of Chilian nitrates was only 100 tons in 1830, 147,000 tons in 1870, then increased to a million and a half tons in 1904, and is now over 2,500,000 tons annually.

The story of the fixation of atmospheric nitrogen can be summed up as follows: in 1902, the Atmospheric Product Company erected in Niagara Falls a trial plant for the manufacture of nitric acid by the Bradley and Lovejoy process. During the same year, de Kowalsky began in Fribourg a series of researches which were continued by Moscicki and led to the erection of a trial station at Vevey, in Switzerland; in 1903, Professor Birkeland, of Christiania, discovered a new process which was afterwards perfected by Birkeland and Eyde, and is now applied on a very large scale at Notodden in Norway. In 1903, also, Frank and

Caro made public a new method of fixation based on a different principle and giving calcium cyanamide as the final product. More recently, Pauling and Schonnherr have taken out patents for other processes.

All the methods quoted above, with the exception of the Frank and Caro process, utilize electrical energy to combine directly the atmospheric oxygen and nitrogen. This combination gives nitric acid which in presence of water and air in excess is transformed immediately to nitrous and nitric acid and finally into nitric acid only; this azotic acid is either sold as such or is led over limestone, giving as final product the nitrate of lime which is utilized in place of the Chili saltpeter or nitrate of soda for all agricultural uses.

Nitrate of lime.—Nitrate of lime was not at first received with favor by the farmers on account of its hygroscopic properties which demand the immediate use of the whole contents of a barrel once it has been opened. However, outside of this inconvenience, nitrate of soda and its consumption as a fertilizer has increased rapidly.

The manufacture of synthetic nitrate of lime has only been carried out so far in Norway by the Norwegian Nitrogen Company, and its subsidiary companies, grantees of the Birkeland and Eyde, and Schonnherr patents.

The chemical fertilizers manufactured at Notodden are nitrates of lime, of potash, of ammonia, of phosphate of ammonia, and of biphosphate of lime; this industry produces also nitric acid and nitrate of soda. The production of nitrate of lime was 9,500 tons in 1909, 14,000 tons in 1911, rose to 50,000 tons in 1912, reached 110,000 tons during the year 1913, and it is estimated that the production in 1915 will be about 160,000 tons.

The Norwegian Nitrogen Company and its subsidiary companies have undertaken, solely for the needs of this industry, the construction of a number of hydro-electric plants, the total capacity of which will reach the enormous figure of 540,000 h.p. There are at present four plants of approximately 180,000 h.p. in operation, with two others totalling 160,000 h.p. in course of construction.

We have seen previously that the world's yearly consumption of nitrate of soda was approximately 2,500,000 tons; but the Chilian saltpeter is not utilized solely as a fertilizer, it is also employed in the manufacture of powder and nitric acid. The statistics of the different countries do not subdivide the consumption of saltpeter, but it is generally acknowledged that industry does not absorb more than 1/5 or 1/4 of the total production of nitrate of soda.

Mr. E. F. Cote, a well-known French economist and engineer, after having analyzed the progress of the different Norwegian industries in 1912, expressed the following opinion concerning the future of the manufacture of nitrate of lime:—

"Four hundred thousand horse-power with the efficiency mentioned above would probably produce 250,000 tons of nitrate. But what is this? Chili exports every year 2,000,000 tons of natural nitrate to Europe; in ten or fifteen years the Norwegian nitrate plants will have attained their full development; but their production then will not be sufficient to take care even of the increased consumption. It is certain on the other hand that the Chilian beds will not be able to indefinitely supply the rapid and continuous increase of the demand, and it will be necessary for industry to develop its own means of production in order to satisfy the urgent needs of nitrogen of the bread-eating nations. This means that the market for nitrogenized fertilizers is practically unlimited and that is why the capitalists have given their backing to the electro-synthetic processes with a spontaneousness which has only been equalled by their boldness."

Limestone is the only raw material required in the manufacture of nitrate of lime, the economical production of which is entirely dependent on the cost of the electrical energy. In Norway, the cost of production of nitrate of lime is very much below the selling price of Chili saltpeter.

Nitric acid.—Synthetic nitric acid is chiefly obtained by the Pauling process, which is similar in principle to the Birkeland & Eyde, and Schonnherr processes. It would seem as if the grantees of the Birkeland and Schonnherr patents had given greater attention to the manufacture of nitrates, whilst the owners of the Pauling rights produce nitric acid principally.

The Pauling furnaces are used in Austria-Hungary, at Patsch, near Innsbruck; there are twenty-four furnaces absorbing 15,000 h.p. Another plant of 8,000 h.p. operates the Pauling process in the north of Italy, whilst in France, the Roche-de-Rame works near Briancon, have utilized 8,000 h.p. since 1908, and will ultimately use 20,000 h.p.

Nitric acid manufactured synthetically is very pure, and is free from nitrous products, from chlorine and sulphuric acid. It is very superior to the general run of commercial acids as the ordinary preparation of it by nitrate of soda does not allow the entire removal of impurities. The by-product of this industry is nitrite of soda which is used in the manufacture of dyes.

The world's production of nitric acid is from 200,000 to 250,000 tons per year, Germany producing about 100,000 tons, and the United States 70,000 tons per year. The margin between the selling price of ordinary nitric acid and the cost of synthetic azotic acid is large and indicates that this industry can afford to pay more for its electrical energy than the nitrate plants.

Calcium cyanamide.—Calcium cyanamide, also called azotized lime, or nitrogenized lime, is an artificial fertilizer containing carbon, nitrogen and calcium.

Calcium cyanamide is manufactured in fifteen different plants located in France, Switzerland, Norway, Italy, Austria-Hungary and Japan. In addition, the American Cyanamide Company has important works in the State of Alabama, and a plant at Niagara Falls on the Canadian side.

The world's production in 1911 was 110,000 tons, in 1912 was 153,000 tons, and in 1913 reached 226,000 tons.

The Canadian plant began operation on the first of January, 1910, with a yearly capacity of 10,000 tons, and has been forced to raise its production to 12,000 tons in order to satisfy the demand of the American compost dealers. The directors were so satisfied with the results of the first enterprise that they decided to double the capacity of their works, and in March, 1913, the production of the plant had been increased to 24,000 tons per year.

ELECTRO-METALLURGY

Aluminum.—Aluminum was the first metal manufactured in a hydro-electric plant. Its manufacture belongs to electrochemistry on account of the electrolytic method employed, and to the electro-metallurgy on account of the nature of the product.

Aluminum is manufactured by electrolysing alumina dissolved in a molten bath of cryolite, these materials being placed in an iron trough lined with carbon and connected to the negative pole of a dynamo while a carbon anode immersed in the charge is connected to the positive pole.

Since 1886, the increase in the world's consumption of aluminum has been phenomenal. The manufacture up to 1890 was in the hands of five companies who raised the production of aluminum from 175 tons per year to 7,300 tons during the period from 1870 to 1890. In those thirty years the average price of aluminum decreased from $1.00 a pound to $0.22 a pound in 1900.

The price of $0.22 per pound did not leave a very great margin of profit, so that in 1900 the five companies amalga-number of available horse-power per square mile is greater in some cases, but it is painful to realize that in the percentage of utilization, we are woefully behind the other nations.

In passing it may be interesting to note, at this par-

nated into an international syndicate to regulate the production and the selling price of aluminum.

This combine caused an immediate rise in the quotations, but in 1907, the patents for the manufacture of aluminum having become public property and the price of copper having fallen very low, the production of aluminum became much larger than the demand for it. This was followed by a crisis which brought about the dissolution of the aluminum syndicate in 1908.

In April, 1911, a new alliance was formed between the different manufacturers of aluminum. The object of this combine was to regulate the selling price, to put a stop to the cut-throat competition which existed since 1908, and to work for the constant enlargement of the market for aluminum.

The extraordinary low prices of aluminum have resulted in the popularizing of the use of the metal and the increase in its consumption in a remarkable manner, so that a return to normal conditions will leave the manufacturers who have been able to face the crisis with a market for their product definitely enlarged and continually increasing.

In 1912, the United States produced 18,000 tons of aluminum. France 13,000 tons, and Canada 9,000 tons.

In 1910 the total power used by aluminum works was over 320,000 h.p., of which 140,000 h.p. was developed in France.

The actual capacity of the plants of the Aluminum Company of America is 90,000 h.p. Moreover, this company has recently signed a contract with the Cedars Rapids Power Manufacturing Company for the purchase of 60,000 h.p. to be used at their Massena, N.Y., plant on the St. Lawrence. The Shawinigan Falls plant is the property of the Northern Aluminum Company, and has a capacity of 20,000 h.p. A French company, the Southern Aluminum Company, has started at Whitney, N.C., the construction of a hydro-electric plant of 70,000 h.p., with furnaces of the same capacity. The whole plant should be in operation by the beginning of 1915.

Zinc, nickel and copper.—Zinc, nickel and copper are also extracted from their ores by smelting in the electric furnace. The production of zinc by the electro-thermic process has been undertaken chiefly in Sweden and in Norway. The production at Trollhattan in Sweden in 1912 was 3,228 tons with eleven furnaces in operation. This plant is to be increased, and will have an ultimate capacity of seventeen furnaces of 1,000 h.p. each and eight furnaces of 500 h.p. each giving a total installed capacity of 21,000 h.p.

In Norway two plants produced a total of 4,000 tons of electric furnace zinc in 1910, 6,600 tons in 1911, and 8,900 tons in 1912.

Industrial reduction of nickel and copper ores by the electric furnace is not as yet an accomplished fact. Dr. Haanel, of the Canadian Department of Mines, and Heroult, the French inventor, who has specialized in electric furnace work, made some recent experiments at Sault Ste. Marie, which lead them to think that it would be possible in the very near future to obtain a commercial ferro-nickel pig by the electro-reducing process.

The Government of Chili has also been making extensive experiments in France on the industrial production of copper, and hopes to be able to effect a reduction of 75 per cent. in the cost of its production by means of the electric furnace.

ELECTRO-SIDERURGY

Pig iron.—For many centuries it has been usual to obtain pig iron by reducing in the blast-furnace charges of iron ore mixed with the proper quantity of fuel and flux.

The modern blast-furnace is the most perfect of all heat utilizers and has a thermal efficiency as high as 80 per cent. In order that electric-furnace pig iron may compete with pig iron produced in the ordinary blast-furnace, it is necessary to have electrical energy at a very low cost.

In 1906, the Canadian Government authorized Dr. Haanel to experiment on the reduction of ore in the electric furnaces known at the time. Dr. Haanel installed at Sault Ste. Marie a Heroult furnace of 250 h.p. in which he made 150 meltings. The experiments at Sault Ste. Marie lasted only a few weeks, but they were followed by experiments in Sweden extending over several years. At Domnarfvet, the tests took place between 1907 and 1909, and were made with several small furnaces which had been invented by three Swedish engineers.

The Swedish Association of Iron Masters considered that the results of the operation of the Gronwall furnace were good enough to warrant the construction in 1910 of a complete experimental plant at Trollhattan near the government's hydro-electric plant. The Trollhattan experiments were continued until September, 1911, and were made in a furnace of 3,000 h.p. The new electric blast-furnace of Domnarfvet is of 12,000 h.p., and should produce 100 tons of pig iron per day.

Iron ores are smelted by the electro-thermic process in California, in Italy, in Norway and at many places in Sweden. The production of electric pig iron in this last country was 122 tons in 1900 against 8,900 tons in 1910 and 17,600 tons in 1912. The world's production in 1912 was approximately 25,000 tons.

The Noble Electric Steel Company of California has in operation three furnaces of a total capacity of 8,000 h.p. There are in Scandinavia twenty furnaces absorbing over 36,000 h.p.

Ferros.—The name "ferro" is used to designate special varieties of pig iron which are used as a final adjunct in the metallurgy of steel. These are ferro-manganese, ferro-silicon, ferro-chrome, ferro-molybdenum, ferro-tungsten and ferro-titanium. The pigs produced in the electric furnace are expensive products of high quality. In 1910, according to the statistics of "l'Industrie Minerale" the average value of ferros produced in the electric blast-furnace was $21.00 per ton, whilst the ferros of the ordinary blast-furnace were sold at $2.00 per ton.

Ferro-silicon.—Ferro-silicon is used in the converting of pig iron for the production of steel. The world's production is over 60,000 tons of ferro-silicon per year. Two Canadian companies manufacture this product: The Lake Superior Power Company, at Sault Ste. Marie, with an electric furnace of 250 h.p., and the Electric Metals Company at Welland operating four furnaces of a total capacity of 5,000 h.p.

Ferro-titanium.—The manufacture of ferro-titanium in the electric furnace is particularly interesting on account of the large deposits of titanium ore in the Province of Quebec. The United States' production of ferro-titanium for the year 1912 has been estimated at 3,763 tons and nearly 600,000 tons of titanium-treated steel have been manufactured, as against 400,000 tons in 1911.

Steel.—It is an acknowledged fact that the cost of producing ordinary pig iron in the electric furnace is so high that it is only in special cases that electric pig iron can successfully compete against pig iron smelted in the ordinary blast-furnace, but the same does not apply to steel produced by the electro-thermic process. The electric furnace used for the production of high and medium grade steel has so many advantages over the other furnaces that its general use appears absolutely certain in the very near future.

There are already more than one hundred and twenty furnaces in operation in the world, and the production of electric furnace steel has risen from 33,000 tons in 1908 to 175,000 tons in 1912. Germany has tripled her production since 1910, and in 1913 had in operation fifteen plants producing about 102,000 tons a year, placing her in the lead of the other countries. The United States, after having manufactured, in 1910, 52,000 tons, including the large quantity of electric furnace steel rails, is now awaiting the results of the use of these rails and is only turning out in the electric

furnace special high-grade steels to the amount of 18,000 tons annually.

The electric furnace is also extensively used for melting steel for castings.

CONCLUSIONS

The different industries which have been enumerated absorb approximately one and a half million hydro-electric horse-power, and Canada's contribution to this enormous utilization of power is just about 3.5 per cent. of the total.

This paper can only be considered as a very brief survey of a very large field and it would be rash to attempt to draw from it any definite conclusions. It is evident that all the industries mentioned above would not be sure of success in Canada, and that every particular case should be studied with the utmost care before trying to attract the investing public.

A number of foreign engineers do not see a very rosy future for these industries in this country, and in order to guard us against an exaggerated optimism the following quotation is taken from an editorial by Mr. Robert Pitaval, a French civil and mining engineer.

"Our opinion, however, after having visited some of the Canadian plants is that the development of Canadian water-powers will take place very slowly. There are two centres of industry: Niagara Falls and Shawinigan Falls, the first being exceptional and unique in the world. It appears that outside of those two power sites it will be very difficult for a number of years to develop others. Everything is against it: the severity of a terribly cold and long winter causing the low-water period, and the consequent shut down of mills to extend for at least six months, the absence of means of transportation (railroads and highways), and the little enthusiasm shown by capitalists for these enterprises, notwithstanding the encouragement given by the Canadian Government. It is impossible to think of enlarging the Canadian works at Niagara Falls, the only place where this might have been done, now that the American and British Governments have agreed to limit the volume of water to be diverted so as to save the beauty of the fall."

"It seems, then, that Canada need not be considered as a serious competitor of the other countries rich in water-powers, or of the world's electro-chemical industry. The proof is in the failure of electro-siderurgy which had every possible chance to succeed in Canada."

More recently, Mr. Pitaval, returning from a visit to Niagara Falls, published the following comment:—

"This means that in the near future there will not be any extra energy available at Niagara, and that we know now the limit of capacity of the great electro-chemical works of this region. These works, situated along the road from Niagara to Buffalo or to Echota, on grounds bought by the Niagara Power Company for this very purpose, have reached their maximum capacity. The electro-chemical centre of Niagara, with a cost per horse-power year of $15.00 on the average, with labor at $3.00 per day, and with the legislative restrictions with regard to the water diversions, will never constitute a serious competitor for similar European plants. The situation at Niagara is far from being comparable with that of the Scandinavian plants which are much more advantageously located."

This opinion is also shared by Mr. Julien Dalemont, electrical engineer, and at one time a lecturer at McGill University. This gentleman writes as follows in the "Revue Economique Internationale" of December, 1909:—

"Besides the difficulties of operation of the hydro-electric plants, it is important to note also a factor which from the very beginning makes the success of these enterprises very doubtful. All the available falls with a few exceptions are low head falls with large discharge."

"There are now a few natural falls whose height exceeds 100 or 130 feet—even 325 feet—but all the artificial falls created by diversions of rivers starting from the heads of rapids, are falls with a low head and a large discharge. Consequently the amounts of money permanently invested in the hydraulic construction and in the machinery are such that the economical return of the enterprise often tends to become precarious."

It seems as if Mr. Pitaval had shown chiefly the dark side of the situation. It is evident that he exaggerates the difficulty of winter operation and, moreover, the objections would apply to the Scandinavian countries as well as to Canada. The great advantage of the water-powers of Sweden and Norway is the remarkable height of their falls and the consequent smaller volume of water required for the same power. Referring to Mr. Dalemont's opinion, it is somewhat consoling to note that he claims to have applied the same criticism to the water-powers of Switzerland.

It would be possible on our navigable rivers to subdivide the cost of development between Navigation and Industry. This would so reduce the cost of the industrial part of development that the unit cost of these low-head hydro-electric plants might compare with the figures of the Scandinavian developments. This Government help has been given to several plants in Europe and America and explains in a measure the apparently low cost of some of their enterprises.

There is no getting away from the fact, however, that the criticism of the two foreign engineers is partly correct We are in a measure handicapped and there are numerous obstacles, economical, educational and physical which interfere with the rapid development of our water-powers.

It is significant to note that the countries who have given to the technical study of their water-powers the greatest number of years have the highest percentage of utilization: Germany, the Scandinavian countries, France and Switzerland, for example, were the first countries in Europe to undertake the systematic study of their rivers and falls, and a glance at the third column of Table I. will show that these nations have now a greater return from their natural forces than the other countries.

It is only recently that such studies have been undertaken here. At present, the Canadian Public Works Department, the Department of the Interior, the Quebec Streams Commission, the Hydro-electric Power Commission of Ontario, and the Province of British Columbia, have undertaken the scientific discharge measurements of some of our rivers and have established gauges all over the country. There has been a vast improvement in this direction, but we were so far behind the other nations that unless our studies are considerably accelerated, we shall forever lag behind our competitors.

It is undeniable that to utilize a greater percentage of our hydraulic forces, we must interest the foreign capitalists. The Scandinavian works have been largely built by the investment of French and English money, and there are no reasons why we should not be able to obtain for our rising hydro-electric industries the financial support of our two mother-countries.

It is safe to say to-day, that through the lack of surveys, of discharge measurements and of gauge readings there are very few of our water falls which could be offered to oversea bankers. To convince these men we must be able to lay before their technical advisers, complete plans to enable them to make in their office a rough estimate of the first development costs; we must, moreover, show them discharge measurements and gauge readings covering a sufficient number of years to allow them to calculate with accuracy not only the minimum power available, but also the average power on which they could depend. The electro-chemical and electro-metallurgical industries require energy at such moderate rates that it would be impossible in most cases to bank on the lowest available power only. These industries must have the help of the periodical power to

lower the average cost of the energy utilized during the year.

The development of our water-powers has also been greatly handicapped by the difficulty in obtaining a clear title of ownership and by the uncommerciality of some of the clauses contained in Government leases.

It is undeniable that we need a separate water-power policy for each province. It seems to the writer, that so soon as the ballot for the formation of Provincial Divisions of the Society has been favorably voted upon, these Divisions should appoint Committees whose duties would be to place before their respective Governments the views of engineers on this most important subject. This action could be considered as a very good form of publicity, and its results would certainly redound to the general welfare of Canada.

Stimulating the Electric Vehicle Industry

A Notable Convention of Enthusiastic Believers in the Future of the Electric—Splendid Operating Records Shown—Prejudice Disappearing

The convention of electric vehicle interests, under the auspices of the Electric Vehicle Association of America, recently held in Philadelphia, was the most important and best attended in the history of the association. The feeling was pretty generally expressed that the electric truck is gradually but surely coming to be recognized as the most efficient and economical method of transportation in the various lines of commercial work for which it is specially fitted. The speed craze, which is probably the biggest factor in the popularity of the gasoline car, is dying down, and people are satisfied that quite as much, and often a little more, can be put into the day's work by using the better controlled, more reliable electric car, even though they may not be capable of spurting on occasion to satisfy the whim of the driver. Economy of operation is also coming to be recognized as a part of the electric. When the car is stopped, so also are the operating expenses, and in many classes of work, such as delivery, the time of standing is in excess of the time of actual running.

Two big obstacles in the way of the electric car to date have been their cost and the lack of facilities for charging. At the present time, charging stations have been fairly well distributed in the larger cities and towns, so that this difficulty is practically removed; in the near future, as these facts become better known, and the points where charging can be taken care of are more fully advertised, the objection will doubtless disappear.

The other obstacle, the first cost of the electric, can only be reduced with increased sales. Up to the present time the manufacturer has attempted too many types of car rather than standardizing on one type to be produced at the least possible cost. We believe they are coming to realize that this has been a mistake and there are already very prominent signs of standardization. Along with this will come reduced cost, and, as a natural consequence, increased sales. These two latter factors are interdependent and each must work to the benefit of the other.

It is very doubtful if there is any real prejudice against the electric car today. One difficulty in the sales situation is that the business has not been sufficiently active and lucrative to justify an agent in devoting his entire attention to the electric car. As a result we generally find that the same agency sell both gas and electrics, and, as the salesman will most naturally follow the line of least resistance, and as he finds that the gas car is easier to sell usually, he concentrates his powers of salesmanship on it and the electric is neglected. These matters, however, are being adjusted, and we believe the time is not very far distant when the electric car will show very decided symptoms of coming into its own.

At the recent convention mentioned above, interesting addresses were delivered by Mr. J. H. McGraw on the subject of stimulating electric vehicle progress; by Mr. F. N. Carle, on the early development of the electric vehicle industry in America; by Mr. W. A. Manwaring, on the general use of the electric truck by central station companies; by Mr. P. D. Wagoner, on the present status of the electric vehicle industry in Europe; and others.

Mr. Manwaring stated that a census taken a twelvemonth ago showed 86 central stations to be using a total of 971 electric vehicles, which number had undoubtedly been increased during the past year. He referred to the capacity of the different types of electric vehicle regarding their mileage and consumption, giving specific examples to show that the daily mileage was anywhere from 24 to 62 under normal conditions, and the kw.h. consumption per mile anywhere from 1.94 down to .39. Mr. Manwaring reviewed the specific case of a fleet of 11 one-ton trucks, which had been in continual service for nine years. The average yearly mileage of these eleven trucks during this period was 4,855 miles per truck with a maximum mileage of 7,017 and a minimum of 4,016. During the ninth year (1913), the average mileage per truck worked out at 5,136 miles, with a maximum showing of 7,756, which would indicate that the trucks are as efficient as they were nine years ago.

Mr. J. H. McGraw spoke encouragingly of the possibilities of installing new life into the electric vehicle business. Extracts from his address also follow:

Stimulating Electric Vehicle Progress

"What can be done to invigorate the electric vehicle business? Two features of the problem which stand out boldly are the wealth possibilities for large development, and the abundant resources among those engaged in the business. Yet in spite of great possibilities there is evidence of sterility in the comparatively little progress made.

"If, therefore, we may be permitted to regard the present situation as unsatisfactory what are the causes? Aside from the generally depressed condition of business throughout the country, investigations indicate that there are three reasons for the slow growth:

"First, the novel character of the business, which, while it has brought large installations in the commercial field and successfully launched the passenger car, has been depended upon to carry the business to a point where exhaustion has set in.

"Second, those responsible for the administrative conduct of the business have done little in a constructive or creative way to open up new lines of endeavor in exploiting their product, and have depended too much upon the routine performance of subordinates.

"Third, defective collaboration from central station companies furnishing energy supply and which has been depended upon as an interlocking necessity, has not been received to the extent to which it must be exerted.

Can be Corrected

"All these elements can be corrected and improved without superhuman effort or extraordinary revolutionary undertakings by simply applying to them such reasoning as will develop adequate comparison with progress made in other

lines of business, and by adopting principles which have been known to bring results.

"Taking up this first cause, we have a condition analogous to that which previously existed in nearly every other field of commercial endeavor where the introduction of new methods or of improved equipment became a problem. The same conditions obtained. Whether it was agricultural implements, railway equipment, sewing machines, telephones, safety razors, pianolas, newspapers, electric lighting or any of the myriad other refinements which have combined to improve our economic and social life, the same ebb and flow has been experienced; and in no case has substantial progress been accomplished until the impediments of novelty have been ruthlessly brushed aside by the stern and irresistible necessities of commercial enterprise.

"This is the case with the electric vehicle. It has hardly reached a transitory stage. It is not yet commercialized. We are still fondling it as a luxury, hesitating to put behind it that dynamic energy necessary to force it upon the public which does not know its value and which is waiting to be convinced that it must have it and use it in great numbers as an economic necessity.

Hard Work Needed

"Considering the second cause, it must be evident to every keen observer that the solution of most of the many difficult problems now left to the salesmen must be made by those justly responsible for administrative functions. The inclination to drift with the tide of things, and be satisfied with business that can be readily secured, without any effort to sift out and win by sheer merit the more difficult but more profitable undertakings, must be checked. The excuse that the business is new and that time is necessary to overcome obstacles is no more valid in this line than in others. On the contrary, the reward which awaits industry in this field is infinitely greater than that which falls to the lot of business projectors in other fields. However, these anticipated results will never be secured automatically. They can only be won when the strongest kind of administrative energy is directed against the obstacles involved.

"The present semblance of weakness must be entirely changed, and upon the administration must be laid the task of discovering, testing, and establishing those methods of organization and management by which all business productive energies may be united, stimulated, guided and rewarded. Then all the possibilities covered by the enormous scope of this industry may be forced to yield that increase in the application of electrical machines, which will transport the entire vehicular tonnage of freight, now moved within the city limits, as well as supply the latest demand for that immense passenger traffic of a domestic, professional or commercial character which only awaits an enforced recognition of the cheap, convenient facilities of the electric carriage.

"It requires but little observation to discover that the field has enormous scope. Every pound of material of any kind within the range of our vision in cities, excepting alone the original virgin soil and natural growths, has been moved at one time or another in some form of vehicle over the city streets. Every building has been carted in on wheels. All the vast equipment we make use of in any way whatever has been transported. In addition there is the enormous quantity of transitory merchandise, constituting our commerce, as well as our consumed materials; the sum total of which transportation might, and probably some day will, be performed electrically. This is a reasonable anticipation, just as in a comparatively short period in the past, similar transformation has taken place in the supply of light and passenger transportation by means generated and supplied by public service organizations.

Enormous City Business

"Some conception of this city vehicle load may be gained by reference to the volume of our transported materials in other directions. The annual tonnage originating on railroads for the past eight years has averaged 800,000,000 tons. An equal amount was transferred to connecting railroads, thereby making the total annual rail tonnage over a billion and a half.

"It would be fair to assume that at least one-third of this finally reached our principal cities and was carried there at least twice over a distance of only one mile. We have a minimum of 1,000,000,000 ton-miles per annum.

"It is generally conceded that the freight tonnage reaching cities is handled many times over, but assuming as above that it was simply handled once from the railway to business premises and afterwards to the consumer, the above 1,000,000,000 ton-miles at an average energy consumption of 5 kw.-hrs. per ton-mile, would at the 4-cent rate reach a total figure of $200,000,000 per annum.

"This equals very nearly the total gross income of all central stations now engaged in business in the United States and if this tonnage were handled for one additional mile the revenue would practically equal the total gross income of all electric railway organizations in the country.

"Now to consider the third cause. It may be well acknowledged that the attitude of the majority of central station organizations is favorable towards the advancement of electric vehicle projects, and that at least a half dozen of the larger ones are conducting organized departments for the advancement of vehicle use. Furthermore, all of them have liberally contributed to the funds of the general advertising campaign which has done such effective educational work in the past few years. However, it is equally plain that the central station effort is not at all in keeping with the enormous vehicle load which stands practically at its doors.

"I have indicated in what direction the salvation of the industry lies. We need to show the central stations of the country the great market offered by electric vehicles when they come into their own, and to induce them to preach their use in season and out of season as they do the use of lamps, motors and heating devices. Freight loads are larger than passenger loads and possess greater diversity. If, therefore, it is profitable to transport human beings electrically, how much more so would it be to transport freight; and if central stations are eager for railway loads, they should be even more keen to secure electric vehicle loads. I think they only need to be shown."

Daily Consular and Trade Reports publish the following rates for electric energy in the city of Cork, Ireland:—

For lighting, 10 cents per unit, including supply and renewal of carbon filament lamps, with 2 cents and 4 cents per unit discount for certain amounts of consumption. For power, the rate is 4 cents per unit up to 1,000 units per quarter; 3 cents up to 2,400 units; 2½ cents up to 5,400 units; and 2¼ cents when over 5,400 units are consumed. The flat rate for cooking and heating is only 2 cents. Small rents are charged for meters. The voltage for lighting is 230; for power, 460.

New Companies

The firm of B. Lefebvre, Limited, have been incorporated with a capital stock of $50,000. The company will engage chiefly in municipal sewerage and roadway construction. The principal place of business will be located at Montreal.

Messrs. Stewart-Warner Speedometer Corporation, Limited, an extra-provincial company, has been registered in British Columbia with head office at London Building, 626 Pender Street West, Vancouver. The company will manufacture and deal in all kinds of engines, dynamos, pumps, etc., and will carry on business as mechanical and electrical engineers. Mr. David Gordon Marshall, Barrister, Vancouver, is the company's attorney.

The Status of the Electrical Engineer

The President of the American Institute Deplores the Lack of Consideration and Respect Accorded the Profession—Are Conditions Improving?

The president of the American Institute of Electrical Engineers each year delivers an address at the annual convention of the institute, dealing with some subject of current interest to the engineering profession. This year's president was Mr. C. O. Mailloux, and his subject, "The evolution of the Institute and of its members." The early part of the address dealt with the development and activity of the institute and its evolution; the latter part, with the social and civic evolution of the engineer. Mr. Mailloux discussed, in very interesting and forceful language, the value of the trained engineer in the social and civil life of to-day and pointed out regretfully that he was not, as a class, occupying the sphere for which his talents, education and training specially fitted him. The standing of the physician, lawyer and the clergyman is recognized, and his functions no longer usurped by the layman. One of the most common occurrences in the civic life of to-day, however, is the decision and management of important engineering problems by laymen with absolutely no knowledge of the matters in hand. Extracts from the latter part of Mr. Mailloux's address follow. They will be read with intense interest and concurred in universally by the engineering profession.

One of the important objects I have in mind, is to bring to the attention of electrical engineers—and, incidentally, to the attention of all other engineers or classes of engineers who are "in the same boat,"—the fact that the acquirement of what might be termed "technical adeptness and dexterity," either individually or collectively, by the members of a profession, and the resulting increase of technical knowledge, accumulaton of experience and data, and development of engineering methods, do not constitute the summum bonum of our professional life, do not represent our only ideals or the sole end and purpose of our efforts, either in an individual or in a co-operative sense.

Engineers too Self-Centred

In extending and improving our relations to each other, through our Institute, we have laid the foundations for the development of a great guild. Let us remember, however, that in this case we ourselves may not, indeed, we cannot, be the sole judges of greatness. In reality, it is not self-recognition, but recognition of a class by all other classes, that counts. This is a point to which engineers as a class have given altogether too little attention. They have been too self-conscious and self-centered; and they have not paid enough attenton to their relations to the outside world. They have neglected to cultivate, and, consequently, they lack, the "guild spirit,"—that force which makes for the increase of prestige, influence and power of the guild, and secures for it the greater respect and consideration of other guilds and classes. It is high time that engineers should appreciate the importance of "taking their place in the procession," in a social, civil, and civic sense. While, in a professional class, the prominence of individuals may depend only or mainly on professional technique and achievements, the prominence, reputation or caste of the class or clan, as a whole, depends mostly, perhaps wholly, on the professional spirit—the "esprit de corps"—and on the ability, of the guild or class, to hold its own with the other guilds and classes, on common grounds, in social, civic, political and other life, in the outer world. The next point of interest is that we really have duties to perform and are entitled to benefits, in that outer world. Moreover, our neglect to preempt or to occupy the place that belongs to us there, is a serious handicap to the prestige or influence of our particular professional class, and places it in a condition of relative disparity, before the world, as compared with other professional classes—such as those of law, medicine, the fine arts, etc., which assert their rights and utilize their opportunities systematically.

When people speak of the "upper crust" of society, they imply and recognize, tacitly, the existence of lower layers, strata or classes in human society. It were indeed idle to deny the existence of classes, orders or groups in human society, any more than in the rest of nature. It seems to be in nature's general programme. We find classes in the infinitely great worlds of the astronomer, and we find them in the infinitely small worlds of the bacteriologist, and in that of the physicist; and we find them everywhere between these two extremes, in the animal, vegetable and mineral kingdoms. An interesting example of the stratification of life was noted by the Prince of Monaco in his deep sea explorations. He found that the ocean had upper and lower "layers," or "tiers" of inhabitants, with an indefinitely great number of intermediate layers; moreover each kind of life, indeed each species of fish or animalcule, has its place at a certain depth, where it is "at home," and above or below which it is "out of its element," and may be so uncomfortable or so handicapped that it cannot live.

In this entire system of stratification in the universe, the relative location of each layer may be the result of accident or circumstances, but it is always liable to change. In the case of the "layers" of human society, some important changes have been effected rather suddenly by revolution; but most of the changes occur by the slower and better process of evolution. The important principle of the "survival of the fittest" is always in operation here, for there is continual battling by contending forces, the weak being crushed or thrust aside by the strong. The social or civic level occupied by any class in human society is at the point of balance or equilibrium between its own efforts to rise to higher levels and the efforts of other classes to prevent them from rising in order to take their place.

It is my opinion, as it is also that of many of my colleagues who have given careful thought to the matter, that as a professional class, we are entitled to occupy a higher station and to receive greater consideration and respect than have been accorded us by the public. I will not deny that we have made considerable progress in the direction of social respectability and higher civil status. A recent review of the evolution of the engineer, in the London Times, contains the interesting statement that "Considerably less than a hundred years ago engineers in the navy took rank next below carpenters." It is most gratifying to realize that, in the present day, in all the navies of the world, the engineer is in the "officer" class and that, at least in our navy, many of them have attained the "Admiral" class.

Rarely Have Final Authority

In an address on "the position of the engineer in civic and social life" presented before an Austrian technical society in 1877, one finds ample evidence that the civil and social status of the engineer were then far from satisfactory to the engineers themselves. There is lament over the fact that the older professional classes, which had hitherto divided the world amongst themselves, looked upon engineers as "upstarts" and "intruders." We may still be considered "intruders" by the lawyers and politicians who fill the positions that we engineers alone are qualified to fill properly on public

service, public works, and other commissions dealing mostly with engineering questions; but, at least, we are no longer called such harsh names. So we have made some progress—just enough, perhaps, to show how far we are still from where we ought to be. The following passage in the address is well worth quoting: "Only in rare, exceptional cases, do we see engineers, even in matters of specifically technical character, vested with the authority which gives the ultimate final decision; indeed, they are never in the majority in the deciding body." Further on, in the same address the statement is made that the final deciding power in matters of the kind already mentioned remains "in the hands of laymen, and that the preponderating majority is composed of amateurs generally having a pronounced legal 'tinge.'"

These remarks, thirty-seven years old, need practically no revision for presentation before an American engineering society to-day. They still report the conditions quite correctly. The author calls attention to the fact that the civil and social status of the engineer are higher in France and in England than in the German countries. The engineer has never been regarded and treated in the former countries as an "upstart" or an "intruder." Of the French engineer, the paper says that his education not only equips him with the necessary knowledge and preparation for the fulfillment of all his technical duties, but that it makes him, in general culture, good breeding and social tone, equal to members of all other social classes, and that he is, therefore, received and acknowledged as such without any opposition. This passage is interesting as evidence of the benefits attainable from the kind of training which supplements technical adeptness and dexterity by the development of personal character along intellectual, cultural, social, civic and ethical lines.

This plea for the proper recognition of engineers, as a professional class, though based upon justice, is, in a sense, a selfish one, and, in urging it too strongly, we might expose ourselves to the charge of being actuated by a desire to gratify professional pride or vanity. Fortunately, the real motive for the evolution of the engineer in social and civic directions is one that is quite altruistic, for the benefits which will result from it for the engineering profession will be trifling in comparison with the benefits to the community, to the state, and to humanity in general. This may seem to be a broad statement, but it can be demonstrated.

Need Citizen Engineers

We know that it is the engineer who, in the last hundred years, has effected the marvellous transformation in the material conditions of life and in the activity of communities which are startling to the historian, and which seem revolutionary to the superficial observer. The engineer has been too busy himself with the multifarious details of this gigantic task to note that what he has done has, in reality, reacted upon the whole structure of civilization to an extent so great that profound alterations, if not entire remodelling and reconstruction, are needed to restore balance and equilibrium. Now, in this task of industrial, social, economic, and political rearrangement and readjustment, there is work for all classes; and, considering the highly technical character of many of the problems involved, there is, especially, much work for which the training and experience of the engineer are important if not indispensable qualifications. It is here that we need the voice and authority of the citizen who is also an engineer; but his place is taken and his authority assumed by the lawyer, the politician, the agitator and the utopist, each having as little useful technical knowledge as the other, but each presuming, nevertheless, to be an expert and an authority on questions that are beyond his ken. Let us note here a significant fact. Public opinion holds so much consideration and has so much respect for the older professional classes—law, medicine and theology—that it would not tolerate the suggestion that the tribunals of justice should be administered by others than jurists, that questions of sanitation or hygiene should be decided by others than medical men, or that moral questions should be settled by others than clergymen. When, however, it comes to questions involving scientific and engineering knowledge, public opinion seems to be satisfied to let them be discussed and settled by anybody whatever, preferably by others than engineers.

Science and Technical Knowledge

In older times, men could qualify for handling the problems of the civilization of their day without reference to technical science, as knowledge of law and religion was the fundamental requirement. A very little science went a long way in an age when sophistry and credulity were at a premium. As a result of the rapid progress of civilization along scientific lines, the importance of law and religion now sinks into insignificance, in comparison with science and technical knowledge as qualifications for dealing with the problems presented for solution. It does not require much thought or imagination to see that, in a society which is becoming daily more and more dependent upon science and engineering for its welfare and well-being, aye, for its very existence, there is more and more room and need for men of technical training at the helm in public affairs.

Some thirty years ago, the then president of these United States stated that "we are confronted by a condition, not a theory." To-day, we have a different state of affairs. We are confronted by both conditions and theories, more especially by a great number and variety of theories, many of them of questionable soundness. This conglomerate condition is owing to the fact that we have too many "quacks," and not enough "doctors," in economics.

A sage of by-gone times uttered the aphorism that there is no royal road to learning. Now, the world would not be so much disturbed or inconvenienced, if it were only royalty that aspired to acquire learning without having to pay the price. Unfortunately, that disposition has become epidemic at the present time, and what is still worse, the appearance is often accepted for the reality, so far as knowledge is concerned, more especially knowledge of civics and economics.

The framers of the constitution of the United States, in making a general statement that "all men are born free and equal," without making it clear that they meant freedom and equality in a civic and legal sense, rather than in a social or intellectual sense, left room for much misunderstanding and confusion. The untutored mind finds encouragement here for the notion that one man's opinion is as good as another's. He does not distinguish between the right to express an opinion, which is a matter of law, and the value and authority of that opinion, which are matters of knowledge. He forgets that while the right may not be disputed, the authority may be both disputed and denied. This self-constituted authority is a source of great mischief, and it is, perhaps, the indirect cause of much of our social unrest or political inconsistencies and our economic disturbances. We are forced to realize and to admit that it puts a premium on ignorance.

Not Possessed by Laymen

The same process of reasoning that makes a man think he is an authority on all political questions makes him a partisan of direct legislation in its most radical forms. Instead of matters being improved, they are made worse. The reason can readily be seen. The burdens thrown upon the individual increase in proportion with the responsibilities which he assumes. In presuming to deal with and pass upon all civic, economic and political questions directly, instead of delegating them to representatives, he assumes implicitly the responsibility for informing himself about every matter, and getting at least as intelligent a grasp and comprehension of it as the representative is presumed to have. But here is precisely where the trouble arises. Many of the questions which he has undertaken to answer for himself, in doing

away with representatives and proxies, and in becoming his own authority and guide, are questions involving and requiring more or less thought and study and inquiry into facts. It is work of a kind for which the average citizen has not the time or the inclination, even if he had the aptitude and the training. How can enlightened thought and opinion and rational action be realized under such circumstances? It seems natural to expect that most of the untutored and indifferent minds in the community will either jump at conclusions or arrive at them in a very superficial way, very much as one may try to get the news by merely reading the heavy headlines in a newspaper. In such a case, it is very important that the headlines should be set up by men who are intelligent, well informed and honest.

It is a momentous question which is asked when we inquire whither the untutored citizens, who constitute always such a large part of the whole mass, will turn to read these headlines, in their search for information; and the answer is far from reassuring. Some may read them in the sermon of a popular divine who is trying to fill the pews by observations on civics, economics, and other technical subjects of which he knows precious little. Others may read them in the speeches and harangues of agitators and fanatics, and no doubt many others find them in the corner saloons in the vaporings of some would-be sage, who, after finding inspiration at the bar, tries to imitate the sapient "Mr. Dooley" in solving the world's problems.

Blind Leading the Blind

The sum total, the net result, of all this dilettantism is a condition wherein the blind are leading the blind. All this confusion, and all the blundering which it entails, could be and may be avoided by putting men and things back into their proper places. In seeking for causes, we are brought face to face with important facts. First, the present disregard for knowledge and authority among the masses, and the transition from a state or condition where a few privileged professional classes or sects were the only ones who presumed and were permitted to think and pronounce on public questions, to a state where all classes and, in fact, all individuals, assume the right and authority to do so, are undoubtedly consequences of long-continued abuse of authority by those who presumed to be the oracles of the people, and made believe that they knew all about things which, in reality, they did not know. Second, it is mainly lack of scientific knowledge that has caused the old-time oracles to fall from grace in the popular estimation. The days when scientific facts could be over-ridden and overshadowed by rhetoric and oratory, are passed. An ounce of technical knowledge is worth a ton of imagination, when it comes to handling scientific facts. The public lost confidence in its oracles because it found out, in time, that it is more important for statements to be true than to be merely plausible. Third, the public is not to blame for not having given to men of scientific training an opportunity to enlighten and advise it in matters of scientific fact and knowledge. The blame lies with the men of the scientific class themselves, for having allowed the public, as a body politic, to remain in ignorance of their very existence, to say nothing of their qualifications. It is unfortunately too true that the civil and social status of the professional engineer are far from being well defined in the mind of the general public. Indeed, there are indications that the scientific education, training, and experience of the professional engineer are very little understood and appreciated in the community. It is not strange, therefore, that the professional engineer should, by many, be regarded as merely a higher grade of skilled mechanic or artisan. To remedy this condition, steps should be taken to inaugurate and carry on a campaign of education of the public, with the object of acquainting it with the engineering class. It is time that engineers should assert themselves as a class and let the public see that they satisfy very substantially the requirements of an intellectual class, and one of more than average grade, as well as of high civic character; that, as such, they are qualified to render important service to the community and to the state, and are entitled to recognition.

Civic, Social and Ethical Service

I wish, at this point, to make it plain and emphatic that the kinds of service and of recognition that I have in mind are not of political, but more of civic, social and ethical nature and character. I would be sorry to see any body of scientific men become a political force and acquire ambition for political power. It would be a lamentable waste and perversion of mental energy of high quality and development. In the beginning of this portion of my address I spoke of the development of the higher and better sides of human nature, and of the evolution of character along the lines of high-mindedness and refinement, as the path over which man can attain to the highest civic and social planes. It is my opinion that not only the engineering class is capable of this higher development, but that it can serve as a strong leaven to promote that development in the community. In a word, I believe that, just as engineering has helped materially to improve physical conditions, so the engineering class can help materially to improve civic, ethical, economic and even moral conditions, in modern life. The education, the training and the experience of the engineer fit him especially for such a mission. He has to deal less with fiction and more with facts than most men of other intellectual classes. He learns early to understand and appreciate the value and utility of scientific method and precision in his habits of thought and expression as well as in his work. He also learns early to distinguish between the classes of subjects with which he is competent to deal, and on which he may presume to speak authoritatively, and those classes of subjects which are not within his sphere or his scope, and in reference to which it would be absurd or even impertinent for him to pose as an authority. He knows that specialties in intellectual work arise from the limitations of individual mental aptitude and energy, and he is willing to concede that the specialist is likely to have more and better knowledge of a given subject than the amateur. He might presume to express an opinion on subjects involving scientific or technical facts; he would hesitate to express one on subjects involving scientific hypotheses or theories; and he would be quite reticent on subjects involving metaphysical considerations or speculations. The subjects of the class first mentioned may be presumed to be wholly within his sphere; those of the next class are likely to be only partly so; and those of the last class are, as a rule, entirely outside of his sphere. The man who has been taught and trained to exercise such discrimination and discretion is qualified for sane, sound, rational, logical, thinking; he is apt to be more careful and accurate in his statements; he usually says what he means and means what he says; and his opinions are bound to carry weight and receive consideration. They make an interesting contrast with those of the man who undertakes to cover all subjects with equal "fluency." It is well known that, as a rule, engineers and scientific men are more conservative in their statements than most men of the other educated and intellectual classes. This is the result of a better appreciation of the limitations of all human knowledge and of the importance of precision in thought and expression; it is, in a word, the result of better intellectual perspective and mental balance. These qualities are very valuable in the citizen, in the member of a community, as they are known to be in the engineer entrusted with important tasks. They only need to be known to be appreciated. They should enable the engineer to command the respect and receive the consideration of the general public, for they are bound to

place him on a high civic plane, and make him an exemplar for the rest of the community.

That is the position to which I would like to see the engineering class attain. The other educated intellectual classes have had their "inning,"—their opportunity. Ours is yet to come. Deserve success and you shall command it. We must deserve and we shall obtain the confidence of the community; and when we secure it we must retain it, by continuing to deserve it. The engineering class can scarcely expect to reach the goal at one bound. It must expect to attain the higher position to which it is entitled among the thinking and intellectual classes by successive stages. It should delay no longer, however, in making a start and in taking the first steps.

I have not by any means exhausted the subject. There is a great deal more to be said, but I shall be content if I have aroused your attention to the importance of not neglecting our evolution along social and civic lines, and beyond the purely technical and professional lines which we have hitherto looked upon too much as being our final goal and the highest realization of our ideals.

I will offer, by way of conclusion, some thoughts summing up the situation, which, I hope, will receive your careful consideration and will be borne in mind by you as having an important bearing upon the further evolution, in a civic and social sense, of the members of this Institute.

Some Suggestions

I. The Institute has made most satisfactory progress in the development of the activities and forces which conduce to its efficiency, which enhance its merits and enlarge its reputation as a forum for the discussion of questions and the study of problems in theoretical and applied electrical science. Its evolution in that sense and direction has been rapid and healthy; and it bids fair to continue to expand its sphere of usefulness.

II. The membership of the Institute, as a whole, has shown extraordinary devotion and loyalty to its interests, and a most edifying zeal in constant efforts to place it on a high plane among the engineering societies of the world.

III. The members of the Institute, as a class, have great respect for high professional ideals and ethics, and they have given enthusiastic and strong support to all movements and measures tending to their development in the Institute.

IV. The members of the Institute, in common with those in the other engineering societies in this country, have paid but little attention to the cultivation of professional ideals outside of the Institute.

V. As electrical men we have pre-empted and we hold a high position in that inner world which constitutes the engineering hierarchy. We have not attained the same high relative rank and position in the outer world, in civil and social life.

VI. In spite of the wonderful achievements which we have performed and the great contributions to the progress of civilization for which we deserve substantially the entire credit, we do not hold the place in the social scale that is commensurate with our professional attainments and our social qualifications.

VII. We have measured our weight and influence as a class by reference to what we think of each other, and by our mutual respect and consideration for each other, forgetting that our social position and status are determined wholly by what the outside world thinks of us, or the respect and consideration which it accords us, or which we demand and obtain from it.

VIII. The time has arrived when the members of the Institute should develop a class spirit through which a man in the engineering profession can attain to the place and high honor and consideration to which he is entitled among the other professional classes.

IX. We must show to the rest of the world that engineers are, by education, training, and experience, as well qualified as any professional class, to discuss, and deal with, public questions and problems, and that in the case of technical questions we are better qualified than are the other classes.

X. We not only fail in our duty to our professional class, but we also fall short of doing our full duty to the community, by remaining silent, in the social and civil background, and by hiding the important light which we are most able to shed on many public matters, by virtue of our scientific and technical training.

XI. We must dispel the popular notion that clergymen, lawyers, physicians, and literary people are still, as in bygone ages, the incarnation of civic wisdom and the epitome of social philosophy, or that they still constitute the only available source of intellectual "high potential" and the only dispensary of advanced thought and knowledge concerning the problems of civilization and human progress.

XII. The engineering class must take its place on a social plane parallel with that of the other professional classes, and must claim, in connection with technical matters within its province, the same consideration and deference to its opinions and decisions that are shown to the other classes under similar circumstances.

A New Ceiling Fixture with Pull Switch Attachment

An excellent type of ceiling fixture which can be used with direct lighting reflectors, has just been developed by the National X-Ray Reflector Company, Chicago. This new device is illustrated in Figs. 1 and 2. The unit is arranged with

Fig. 1.

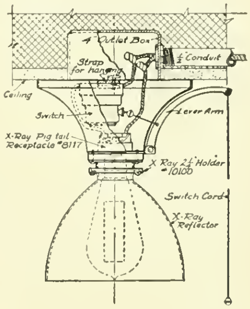


Fig. 2.

a strap for attaching to the lugs of a standard outlet box, or to a fixture stud, and is especially desirable for installation in shops, factories, work rooms, stores, garages, printing plants, power plants, kitchens, laundries, etc. It is approved and can be used without insulating joint. The unique and very desirable feature of this fixture is the switch and lever arm attachment, which enables the individual unit to be controlled independently of the other units on the circuit. The fixture can be obtained with or without the switch attachment. Three types of shade holders have been developed for use in connection with this ceiling fixture, the 2¼-in. form "O," 2¼-in. form "H," and 3¼-in. form "A." The interchangeability of parts makes it possible with this fixture, to cover all ordinary requirements as to lamp size, style of reflector and height of suspension.

Mr. G. J. Smith has been appointed electrical inspector of the city of St. Catharines.

Mr. R. F. Morkill, signal engineer of the Grand Trunk Railway, who joined the first Canadian contingent and was gazetted a lieutenant, is now engaged in important work in Europe for the Imperial authorities.

Electric Railways

Railway Companies Unduly Blamed for Electrolysis Troubles of the Past

Experimental work has recently been completed by E. H. Scofield and L. A. Stenger, respectively engineer and chemist of the Minneapolis Railway Company, which show that electrolytic corrosion can occur where there is no possibility of stray electric currents being the cause. This is a particularly interesting announcement in view of the charges so frequently made against railway companies that their stray currents are the cause of a large amount of the pitting and final destruction of underground metallic pipes of various sorts. These experimental results are given in detail in a current issue of the Electric Railway Journal, a resume of which we reproduce below.

The authors in their introduction call attention to the fact that corrosion occurs on steel, wrought iron, cast iron and lead, both in the form of uniform rusting or oxidation at the surface and as the more destructive pitting. The former is generally recognized as a simple chemical action, limited in its effect and not likely to destroy the metallic material. Pitting, however, is usually attributed to electrolysis and, when found in localities where electric railways operate, it has been the custom in the past to suppose that this action was the result of escaped return currents of such railway systems. The discovery of numerous cases of pitting where there was no possibility of the presence of electric currents in the earth originating from commercial electric circuits, led the authors to search for other causes. The investigations disclosed two classes of phenomena. The first affects metals containing more or less of impurities in their structure, such as cast or wrought iron or steel; the second deals with any metal, regardless of internal impurities, such as lead, which, from its peculiar chemical properties, is ordinarily regarded as non-corrosive; it is found that, when such metals are buried in two different soils, however, a corrosive action is set up.

Impure Metals

It is well known that when impure metals are immersed in or subjected to the action of electrolytes, electric currents are set up. This fact has been advanced as an explanation of the damage done to many metals exposed to the atmosphere, but it appears to have slipped the attention of engineers in the past, that a corresponding effect may result when impure metals are exposed to or in contact with soils. Experiments performed by the authors of this paper, however, show that such a condition constitutes a more or less active electric battery, in which the current will continue to flow unless prevented by polarization, which, the experiments further show, does not take place. A typical experiment was to form a cell of two pieces of cast iron, the space between being filled with moist peaty soil. The two iron plates connected through a milliammeter and a voltmeter gave .004 amperes and .7 volts. These values remained practically constant as long as moisture was present. The authors conclude that the damage done by corrosion to a number of samples submitted for their inspection was fully accounted for on the basis of natural soil corrosion.

Pure Metals in Different Soils

The condition that causes damage from corrosion of the second class arises from a combination of metal and two soils of different composition. This condition is based upon the fact that an electric current can be generated by contact of two solutions of different chemicals. The same condition is produced practically by bringing two soils in contact, one of which contains any soluble substance subject to chemical change. The current enters and leaves the metal, which acts as a convenient conductor in the proximity of the soil and produces corrosion where it leaves the metal.

To demonstrate this theory, electrodes of various metals were used. The cell was made up of two different types of soil in contact and a lead electrode, for example, was placed in each cell with the two electrodes connected through a voltmeter. A voltage was generated when the lead electrodes were in different soils, but not when they were in the same soils. From a number of tests with different metals and soils, the authors are able to sum up their conclusion as follows:—

"The corrosion results of these tests and the appearance of the specimens are such as to fully explain all observed phenomena usually attributed to electrolysis by ground leakage currents. The cast-iron samples, where corroded, were covered with a hard scale of red rust and soil. The pits in the cast iron were filled with carbon and black-iron oxide. The pitting was localized, the space between pits being but slightly corroded. The lead samples show the presence of both the gray and brown oxides. The line between corrosion and non-corrosion, where the metal was exposed to two kinds of soils, is sharply defined. Potential differences up to 1 volt were generated by placing different metals in contact with certain soils, or by placing two pieces of similar metal in contact with different soils."

Annual Report on Poles and Ties

The Forestry Branch of the Department of the Interior, Ottawa, Ontario, have just issued their annual report on poles and cross ties used during the calendar year 1913. The statistics are divided into two groups, namely, (1) steam railways, telephone and telegraph companies; (2) electric railway, power and lighting companies.

The total number of poles purchased in 1913 was 534,592, as compared with 608,556 in 1912. White cedar still represents by far the largest number, being 264,267, though this is a decrease from 1912, when 378,369 were purchased. Spruce also shows a decrease as does also jack pine and balsam fir, the latter from 38,000 to 1,437. A slight increase is noted in the purchase of red cedar poles and a considerable increase in tamarac, from 36,158 to 115,517.

The number of poles purchased by electric railway, power and lighting companies amounted to 65,071, as compared with 58,996 in 1912. There was a decrease in white cedar poles, but a considerable increase in red cedar. A few tamarac, cypress and western larch are also represented in this year's list. The average price for 1913 was $5.45, as compared with $4.79 a year ago.

The number of cross ties purchased by electric railways

during 1913 was 391,223, as compared with 483,362 in 1912. The average value was 58 cents, as compared with 50 cents in the previous year. Of the total number, white cedar is still in the majority with 145,659, though this is a slight decrease from the previous year. Tamarac, hemlock, spruce, douglas fir and hard pine also showed decreases, especially noticeable in the case of douglas fir which dropped from 156,930 to 5,982. An increase is shown by red cedar from 25,000 to 95,000 and by jack pine from 25,616 to 66,954. Also by oak from 2,925 to 14,760. Western larch, beech and maple were represented for the first time by 2,512, 152, and 61 respectively.

About ten per cent. of the cross ties purchased by both the steam and electric railways were given a preservative treatment to retard decay. This is a recent development as is shown by the fact that in 1910 practically no ties were treated at all and that the amount of treated material has increased steadily since that time. The treatment under present market conditions is more profitable when applied to the harder and stronger woods which, when used untreated, would decay before the end of their mechanical life.

Basis of New Agreement

The mayor of Montreal has submitted the basis of a new agreement between the city and the Montreal Tramways Company. Several previous attempts have been made to come to terms, but nothing tangible has resulted. The present agreement does not expire until 1922, and the suggestion is that the term be extended so as to make it cover a period of thirty years. The company have long term franchises in certain outlying districts; these are to be surrendered in favor of the thirty years' franchise covering the entire city. The company are to make extensions in stated districts, and to pay half the cost of the removal of snow, $12,000 per annum for street watering, and one-half the interest and sinking fund for work ordered by the Quebec Utilities Commission. The city undertakes to construct a rapid transit railway under St. Lawrence Boulevard, and similar lines if necessary, at other points, the company paying an annual rent equal to the interest paid by the city on the capital expenditure and to furnish the necessary equipment; during the last ten years of the contract the city is to receive one-half of the gross earnings of the subways after deducting the cost of maintenance and operation. The fare is not to exceed 5c, and after midnight to 6 a.m., 10c. The city will introduce a bill seeking the necessary authority, and also for the company to acquire the Mount Royal Park incline railway. The company are to be granted a franchise for an autobus service on certain streets, if the city have the power, while the company will also be given authority to carry on a ferry service between St. Helen's Island and the Montreal harbor. In the event of the city not expropriating the company's property at the end of thirty years the contract is extended in periods of ten years until expropriation takes place. It is proposed that the present percentage of receipts paid by the company shall be abolished, in view of the fact that the company under the arrangement proposed will be giving a five cent fare to certain outlying districts in place of the ten cents now charged. Mr. Herbert, one of the controllers, has prepared an alternative report in favor of an engineer making an examination of the entire transportation problem and also of the construction of subways, either by the company or by the city.

Asked to Vote Again

Newmarket town and Uxbridge township, the two municipalities in the hydro radial area that registered an adverse vote against the scheme, will be asked to take another vote upon the proposition. It is felt that the favorable votes recorded in the other municipalities will probably carry sufficient weight with the electors in these two municipalities to reverse the situation.

Safety First Corporation

The city of Montreal has decided to co-operate with the Montreal Tramways Company in the Safety First campaign inaugurated this year by Superintendent Gaboury. The chief of police is to work with Mr. Gaboury, and later a committee of civic officials is to be formed to study the entire question as it relates to Montreal. The chief of police has sent out thousands of circulars to holders of vehicle licenses, referring to the urgency of observing traffic regulations, and also making suggestions how to avoid accidents. Mr. Gaboury states that the number of accidents has been reduced as the outcome of the campaign earlier in the year.

Would Build Private Road

The Canada Wire & Cable Company and other Leaside interests have offered to construct a car line in North Toronto, connecting with Mount Pleasant Road. This line would be used chiefly for transporting the employees of these companies, who live over towards Yonge Street. It is stated that the lines would be handed over to the city as soon as they could be operated as a part of the civic system.

New Books

Electric Cooking, Heating and Cleaning.—Manual of electricity written in the interests of home life by Maud Lancaster, and edited by E. W. Lancaster, A. M. I. C. E., M. I. E. E. American edition. Published by D. Van Nostrand Company, New York. This book endeavors to explain certain of the elements of electricity in such a way that the housewife may understand. It then proceeds to point out the advantages of the use of electricity in cooking, lighting, heating and cleaning in the home and school. A very complete list of domestic electric accessories is described, assisted by some 300 illustrations. So far as we know, this is the first book of its kind to appear on the market and should be a welcome addition to the library of every domestic household.

Electrical Measurements—By A. J. Bushnell and A. G. Turnbull. American Technical Society, Chicago, publishers. Price $1.00. A practical handbook covering the design and construction of measuring instruments and their use in the measuring of current, resistance and commercial power, with special reference to watt-hour and maximum demand meters. Practical presentation of the subject with excellent illustrations. This book will find a wide application among users of commercial power and among those who are interested in increasing their knowledge of electrical instruments; contains 170 pages.

Practical Lessons in Electricity—by R. A. Millikan, Ph.D., F. B. Crocker, M.A.I.E.E., and John Mills, A. M. American Technical Society, Chicago, publishers. Price $1.50. This is a simple presentation of fundamental electrical principles and their application to direct and alternating current problems. The book is specially adapted for the purpose of self instruction as well as being a manual of information for the experienced electrical worker. Splendidly illustrated and thoroughly up-to-date; 249 pages.

Applied Electro-Chemistry & Welding—by Chas. F. Burgess, E.E., and Geo. W. Cravens, M.A.I.E.E. American Technical Society, Chicago, publishers. Price $1.50. This is a practical treatise on commercial chemistry, the electric furnace, the manufacturing of ozone and nitrogen, high tension discharges, and the application of electric, gas and chemical welding to manufacturing and repair work. The book is written in a clear, readable style, designed for the layman as well as the trained engineer. A study of this volume should greatly widen the acquaintance of readers with this branch of industrial electricity and stimulate their interest in general scientific developments. Well illustrated; 215 pages.

Illumination

Illumination as a Safety Factor in Industrial Plants

By R. E. Simpson*

From time to time we read in the technical press that 500,000 avoidable accidents occur in the United States every year, and that of this number approximately 25 per cent. are due, directly or indirectly, to inadequate illumination or improperly placed lighting units. To get proof of this statement in the form of statistics is almost impossible. Reports are issued annually by the labor bureaus of various states, and by the Federal government, containing tables giving the number and causes of various classes of accidents. The causes that are listed include the breaking of hoists, cranes, winches, and other machines, the bursting of grindstones and emery wheels, the improper use of circular saws, lathes, and presses, contact with mill gearing (shafts, pulleys, and belts), and persons falling or being struck by falling tools or other objects. Rarely, if ever, is poor illumination among the list of causes, although many of the reports mention poor illumination as an indirect or contributory cause. The paucity of statistics on the relation of illumination to accidents is responsible, in a measure, for the apathy of factory owners and managers toward their lighting conditions. A manager, upon noting that such and such a number of workmen were injured by unguarded gears, at a cost to the employer of so many dollars paid to the injured employee in the way of compensation or in the settlement of damage claims, is often led to see that his mill has adequate protective devices; but there is very little chance of his attention being directed to his lighting conditions by the statistics, and if it is true that 25 per cent. of the avoidable accidents are due to inadequate illumination, he is overlooking an exceedingly important item.

Spotted Illumination

The following incident which recently came to the writer's attention illustrates the evils of "spotted illumination" and the danger to workmen if one of their number is afflicted with retinal asthenopia or temporary blindness, and shows how easy it is to overlook the real cause of an accident. Two men were at work in a shop lighted by electric incandescent lamps, equipped with obsolete tin reflectors suspended close to the work. The upper zone of the shop was in semi-darkness—a condition which became more pronounced to the workmen as they looked up from their work. Some sections of the machinery and floor were brightly lighted, while others were dim. In going to another part of the shop one of the men stumbled over a casting that was lying on the floor, and in an effort to save himself from falling he blindly put his hand on a belt-shifting rod which controlled the machine of another workman in the next row. This action threw over the belt and started the other machine. Fortunately no injury resulted, as the second workman had just finished a piece of work, and was engaged at the time in selecting another piece to put in his machine. It can readily be seen that a serious accident might have happened if the second workman had been engaged in adjusting the work in his machine, as he would have been totally unprepared for the starting of the machine.

The two men had a wordy war, the first blaming the man who had left the casting on the floor, while the second workman accused the first one of stupidity. Neither of them, apparently, considered the fact that the first workman was demanding an extraordinary performance from his eyes. There was marked difference in the reflecting values of the two parts of the castings on which he had been working. One part was highly polished and had a high coefficient of reflection, while the other part was a dull iron-grey having a low reflecting value. The man's eye muscles had been under constant strain in an effort to adjust the pupillary opening to the light-reflecting conditions—the opening remaining relatively small, however, so long as the eyes were focused on the work. When he turned from his machine his eyes were compelled to adjust themselves to the change from a brightly lighted field of view to a dimly lighted one; and inasmuch as the eye muscles do not enlarge the pupillary opening as quickly as they contract it, he was laboring, for a time, under a serious handicap.

If the incident had had a serious ending, the newspapers would have reported the accident as due to a fellow workman accidentally moving a belt shifter and thus starting up his comrade's machine; but an impartial and well-informed jury would have given improper illumination as the cause.

To many persons this incident may seem trivial, and it would be so if it were an isolated case. There are hundreds of factories in this country where the lighting conditions are similar to those that prevailed in the case just cited, and these conditions are responsible, in the aggregate, for thousands of what might be termed potential accidents. The stage is all set and ready, and the frequency of accidents, or freedom from them, is largely a matter of chance, with the odds greatly in favor of the accidents. A little attention to the lighting details in these factories would materially reduce the chance of accidents, and would therefore reduce the number of them.

Require Good General Lighting

From a safety standpoint, as well as from a general illuminating engineering standpoint, intense local lighting, as the sole means of providing artificial illumination in a factory, is undesirable. A minimum of two-tenths of a foot-candle should be provided in all parts of a factory where a moderate degree of local illumination is required. In plants where fine tool-work is done, and fine bench operations are carried on, so that intense local lighting is required, the minimum for general lighting should be one-half a foot-candle. This minimum is also essential in a shop filled with moving machinery, especially if the men are required to go from one part of the shop to another in the performance of their duties. Sharp contrasts between the intense local illumination increase the hazards, because the employees, on account of their inability to see clearly, are apt to trip over obstructions in their path, or become caught in the machines or belts.

It may seem to some that I am giving too much em-

*Read before the Illuminating Engineering Society.

phasis to the subject of falls as a cause of accidents, but statistics show that this is not the case. The annual reports of the British factory inspectors show that for the year 1911 there were 379 fatal accidents caused by machinery moved by mechanical power, against 377 due to persons falling. The figures for 1912 are 382 and 419, respectively. Very few industries are exempt from accidents due to falls. They are most frequent in construction work and in shipbuilding, and in foundries and iron and steel rolling mills—industries in which poor illumination is notorious. Poor lighting on stairways and in passageways and aisles in shops is responsible for quite a fraction of these accidents. In many cases the working area in a shop is well lighted, while no provision whatever is made for lighting the stairways and passageways. There is no work done in these places, and for that reason it does not occur to the owner that they should be lighted. The steps of the stairways are generally dark-colored and worn round at the edges—conditions which increase the hazard. Substantial rail guards and stair treads, and lighting units with proper reflectors, should be part of the equipment of every stairway.

Danger Points Without Lights

During a recent inspection the following conditions were noted. A 12-step stairway at one end of a room led from the basement to the first floor. The nearest lighting unit in the basement (an unshaded carbon lamp) was 35 feet from the foot of the stairs, and the nearest unit at the top was 20 feet away, a shadow being cast at the top by a post between this unit and the top step. An unguarded driving belt, extending half-way over the stairs, ran parallel to the stairway at a height of 5 feet 7 inches. The belt was operated so that the turn on the under side ran down with the stairs. A person coming in contact with the belt would receive an impetus sufficient to hurl him to the bottom of the stairs, causing him serious or even fatal injury. The belt should have been equipped with a guard painted white, and adequate light should have been provided so that anyone could clearly see the guard and the steps. When this was pointed out to the manager he agreed that these precautions should be taken, confessing at the same time that the danger had not occurred to him.

This brings out the point that making the general working conditions safer is often a matter of looking into the details of the lighting situation. The shop engineer and manager will generally give heed to the cost of installing, the cost of operation and maintenance, and the location of the lighting units, in the shop where work is performed; but the stairways and passageways, if considered at all, are provided with a lamp here and a lamp there, without due regard to the demands of safety.

In the shipbuilding trade a large percentage of the accidents that occur are caused by falls, and of this percentage the lack of proper lighting facilities is the greatest single factor. When a ship is building or being repaired, artificial lighting must be depended on, all the time, in almost every part of the ship. Generally speaking, adequate light is provided at the points where work is performed, but the lighting facilities from the working point through the ship to the shore are sadly neglected. The opportunities for falls are numerous, especially when the ship is being fitted out after launching. Open hatches, uncompleted and unguarded stairways, and gangways seldom, if ever, sufficiently lighted, are directly responsible for many serious and fatal injuries. If ship owners or builders would go to the slight expense of providing guard rails about stairways, platforms, bunker hatches, and openings into the hold, and see that these points are well lighted, the accident rate would be materially reduced.

Few of our large buildings have been erected without a certain number of the workmen being more or less seriously injured. We are all familiar with the appearance of a building under construction—the street protection, the piles of building material, the single-plank walks over the beam layers and the uneven and unfinished floors, and the gloomy appearance of the first floor in particular. Building material such as bricks, sand, and cement, must be taken by hand from the point of delivery into the building, and the foremen usually drive the men so that the delivery wagon and the materials brought by it will obstruct street traffic as little as possible. A very limited number of lighting units are installed, in a more or less haphazard way, and these are depended on to light the working space and its numerous danger points. When the building is finished and the dangerous places have been eliminated, the amount of illumination is increased many fold. This, of course, is not at all consistent. The lighting facilities should be just as good during construction as after. Workmen carrying building materials are continually going from the bright daylight into the poorly lighted building, where they are unable to see their way clearly because of the great contrast in the lighting conditions; and this, together with the uncertain footing, greatly increases the hazards of their work, and is directly responsible for many accidents.

A great deal has been written and said in recent years respecting the merits, especially in the way of efficiency, of various kinds of lighting units. Salesmen have besieged factory owners and managers, the daily press and technical journals have been flooded with advertising literature, and bulletins have been spread broadcast, all for the purpose of bringing about a substitution of the more efficient units for the old, inefficient ones. The success of these campaigns is attested by the remarkable increase in the sales of the tungsten filament lamps, at the expense of the carbon and gem filament lamps. It is true that the introduction of the tungsten filament lamp has increased the degree of illumination in our factories and is an important item in the conservation of our resources; but I am of the opinion that it is equally true that the introduction of the tungsten filament lamp is the largest single factor for the increase of accidents in our industries during the period of artificial lighting.

The factory managers have gradually recognized the saving effected by the use of tungsten filament lamps. They have purchased them in large quantities, and have fatuously believed that by simply unscrewing a carbon or gem lamp from the socket and replacing it with a tungsten filament lamp of higher candle-power, of greater brilliancy, but consuming less energy, they have bettered the working conditions of their employees and made a certain saving in their lighting bill at the same time. If the old lamp had a shallow, obsolete reflector, this reflector was left in place—not even the dust and dirt on it being disturbed. If no reflectors were in use, new, up-to-date ones were seldom purchased at the time of the change in lamps. The manager noted the reduced lighting bill, and may or may not have noted the increase in the number of accidents. Assuming that he did consider this item, an admonitory notice recommending more care and vigilance may have been issued, and not much thought given as to the cause of the increase in accidents.

Over-Illumination is Bad

It is well known among engineers that the rays of light coming directly from a light-source into the eye reduces the efficiency of the eye as a piece of visual apparatus. It is axiomatic that if a man cannot see his danger he is more apt to be injured than he would be if the danger were evident. An unshaded carbon filament lamp, directly in the line of vision, has a certain deleterious effect on the workman's rate of production and on his safety; and if for this carbon filament a tungsten filament lamp with an intrinsic brilliancy two or three times as great be substituted, a slight increase in the

quality and quantity of product may be evident, but this is gained at a considerable reduction in the factor of safety.

A 100-mile journey along a trunk line through a thickly settled territory would make a vivid impression on a person acquainted with the principles of illumination. The factories along the right-of-way give the impression of being well lighted—and so they are, if judged by the aggregate candle-power emitted by the light sources. A close observer would note, however, that many of the principles of good illumination are violated. There seems to be a decided lack of attention paid to the details of mounting-height, spacing, and reflector equipment, all of which have an important relation to the effective illumination. A good-sized reflector factory would have all the business it could handle for some time to come in equipping the factories between Hartford and New York with reflectors.

Just prior to an inspection the superintendent told the writer that his mill was well lighted, and several times during our walk through the mill he complimented himself on the good illumination. There was one tungsten filament lamp, 150-watt size, suspended 7 feet 6 inches from the floor in one part of the room, just in front of a cutting machine. It was a clear lamp and the only one in the entire establishment with the dignity of a reflector, the reflector in this case consisting of a shallow piece of opal glass, 6 inches in diameter. The rest of the lighting equipment consisted of 16 candle-

Fig. 1—Sacred Heart Convent, Vancouver, B.C.

power and 32 candle-power carbon lamps without reflectors, a few of them suspended 7 feet from the floor, but most of them from 5 to 6 feet. It required less than five minutes conversation in the superintendent's office to show him the waste in using carbon lamps, and the greater safety and comfort of the employees and better lighted working space from the use of tungsten lamps equipped with modern reflectors and with the whole unit properly placed.

There is a crying need for a greater concentration of effort for the protection of the ultimate consumer of light, the eyes. Engineers and chemists have evolved lighting units, which if properly applied, will produce adequate illumination in our factories at a cost so slight that it is all out of proportion to its importance. The real problem seems to be the scarcity of men who are qualified to deal with the subject, and who can devote their time to it. There is a field for many times more men than are now available. The "Safety First" movement, and the recently enacted compensation laws, are creating a demand for expert advice on all matters pertaining to safety and sanitation, and the subject of proper lighting is bound to receive greater attention from factory owners than heretofore. It is here that the services of the illuminating engineer will be in demand, and in dealing with the problems he should bear in mind that one of the principal safeguards for any workman is unimpaired vision.

Typical Semi-Indirect Lighting—The Importance of Proper Installation

Many installations of semi-indirect lighting have proven failures through a certain carelessness in the installation of the system. Like any other system, if not properly installed the results will not be satisfactory. Many people labor under the mistaken idea that to take any sort of a bowl or dish made of glass or other reflecting or diffusing material, suspend this with a few chains and enclose a few lamps, is

Fig. 2 Mason & Risch Piano Co., Vancouver, B.C.

productive of semi-indirect lighting. Any installation planned so carelessly would necessarily be a failure.

We are showing in the illustrations accompanying this article several installations which have been carefully planned and in which the results are pleasing and effective.

Primarily, attention has been given to the requirements of the particular room to be illuminated. The next step is to determine the amount of light necessary to carry on the particular work to be done in that room. After having found the approximate intensity of light necessary, the next step is the selection of a reflector which will make the best use of the light produced. By far the most important point in

Fig. 3—Toronto Public Library, Toronto.

this is to select a bowl or shade of proper curvature to send the light where it is needed. Glass manufacturers have produced quite a variety of designs so that a selection in harmony with the other decorations in the room can be easily taken care of.

The position of the lamp inside the reflectors is important; likewise the hanging heights; hence it is not safe for the ordinary layman to try to get results from semi-indirect

illumination, but it is necessary to consult the services of an Illuminating Engineer or some one familiar with the conditions necessary to produce good results in this way.

Fig. 1 illustrates an installation of semi-indirect lighting in the Sacred Heart Convent, Vancouver, B.C. (architect C. D. Badgley). Here, pressed Alba hemispheres are used and mounted in an appropriate band and in harmony with the decorations in the church. The result is a uniform distribution of light, and an artistic fixture, simple and consistent with the spirit of the building.

Fig. 2 illustrates an attractive lighting equipment in the show room of the Mason & Risch Piano Company, Vancouver, B.C. (Messrs. Parr, Mackenzie & Day, architects). A more elaborate bowl is used here, likewise an elaborate mounting. Attention is also called to the semi-indirect bowl on the bracket to the right of the illustration. The selection of glass and fixtures is consistent with the decorations of this very beautiful sales room.

Much thought was given to the selection of fixtures and lighting equipment for the Toronto Public Library and after many experiments the lighting as shown in Fig. 3 was adopted. In this particular room photographs and prints are shown and the general effect is cheerful and comfortable (Wickson, Gregg & Chapman, architects).

Fig. 4—St. Joseph's Hospital, Vancouver, B.C.

Good results have been obtained by the use of some of the regular direct reflectors inverted. While as a rule it is not suggested that a direct reflector turned upside down will answer for semi-indirect illumination, an exception has been found in the use of one or two designs of tungsten reflectors with the use of a harp arrangement, or a four-armed fixture. Attention is called to Fig. 4, which shows the lighting of the corridors in the St. Joseph's Hospital, Vancouver, B.C. A very simple fixture is used here with the harp arrangement. One hundred watt Alba shades are used with very good results. The fixture is simple, sanitary and adequate for the purpose intended.

An interesting installation of a similar nature is shown in Fig. 5, which illustrates the lighting equipment used in the Imperial Life Assurance Company's offices, Toronto, Ont. One hundred watt direct reflectors, inverted here also, produce a very efficient lighting equipment. There are no strong shadows but a uniform illumination throughout the room, which makes working easier, prevents eye-strain and fatigue, headaches and nervous exhaustion.

Another novel installation of Alba glass is in the Orpheum Theatre, Vancouver, B.C. (Jas. J. Donellan, architect). See Fig. 6. Bowls used as plaques on the parquet boxes and

Fig. 5—Imperial Life Assurance, Toronto, Ont.

the acorn shaped diffusing globes complete the decorator's scheme and illuminate the ceiling and upper walls.

Many mistakes are made in the installation of lighting equipment; some by the use of too much light; some by a too elaborate fixture; some by insufficient light; some by unsightly fixtures.

Engineers and interior decorators have agreed and concluded that the successful lighting equipment is that which produces sufficient light at moderate cost in harmony with interior decorations but at the same time is not so conspicuous as to be specially attractive itself. There is a subtlety in good lighting which when correctly installed produces comfort without the cause being too evident.

Fig. 6—Orpheum Theatre, Vancouver, B.C.

Provision is made in the budget of the lighting department of the Montreal Council for an expenditure of $50,000 for the improved lighting of St. Catherine and Bleury Streets. It is also proposed to spend $92,000 on a new police alarm signal system, designed by Mr. A. Parent, civic lighting superintendent. A feature of this is the deposit of numbered keys with responsible citizens, who will thus be able to ring for aid in case of necessity.

The Dealer and Contractor

Electric Gifts Most Appropriate

A number of further illustrative cuts of electrical equipment suitable for Christmas gifts and which reached us too late for our November 15th issue are shown herewith.

Fig. 74 represents an automatic electric stove oven manufactured by the Berkeley Electric Cooker Company, Berkeley, Calif., known as the $av-R steam oven. This stove is cylindrical in design, enclosing a copper receptacle for aluminium vessels. This cylinder is well insulated for storing the heat. The copper receptacle is made of two copper jackets, between which is contained a quantity of water and a hollow space from which the air has been drawn, leaving a partial vacuum. With the application of electricity, the water is converted into steam, this operation beginning at about 68 degrees. This steam fills the entire enclosure surrounding the cooking vessels. It is claimed that the temperature of this steam is easily regulated, and that the quantity of electricity used is very small.

Fig. 75 illustrates a twin toaster by Landers, Frary & Clark, New Britain, Conn. It is claimed that toasting bread with this equipment can be done in much less time and at less expense than toasting over an ordinary fire. This is a very reasonable contention, when we consider the time and fuel wasted in an ordinary coal range over the making of a piece of toast.

Fig. 76 shows a general utility motor manufactured by the Fidelity Electric Company, Lancaster, Pa., and operating, in this instance, a sewing machine. This is one of the most acceptable presents a housewife could receive at this season of the year.

Fig. 77 illustrates the well-known Dumore motor of the

Fig. 74—Electric-Steam Cooker—Berkeley Electric Cooker Company, Berkeley, Cal.

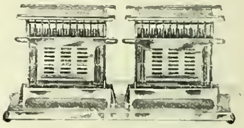


Fig. 75—Twin Toaster—Landers, Frary & Clark, New Britain, Conn.

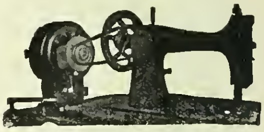


Fig. 76 Sewing Machine Motor—Fidelity Electric Company, Lancaster, Pa.

Fig. 77—Dumore Sewing Machine Motor—Wisconsin Electric Company, Racine, Wis.

Fig. 78—Chafing Dish—Simplex Electric Heating Co., Cambridge, Mass.

Fig. 79—Coffee Urn—Simplex Electric Heating Company, Cambridge, Mass.

Fig. 80—Coffee Urn—Landers, Frary and Clark, New Britain, Conn.

Fig. 81—Sad Iron—Landers, Frary and Clark, New Britain, Conn.

Fig. 82—Electric-Steam Cooker—Berkeley Electric Cooker Company, Berkeley, Cal.

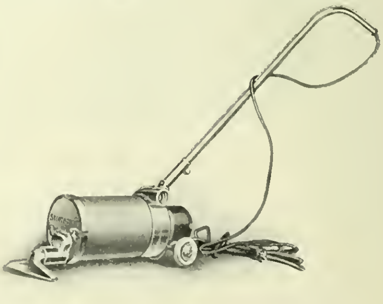


Fig. 83—Portable Vacuum Cleaner—B. F. Sturtevant Company, Boston, Mass.

Wisconsin Electric Company, Racine, Wis. This machine will operate on d.c. or a.c., 104-125 volts, 60 cycles or under, and is claimed to have eliminated in its construction the majority of the objectionable features of the earlier types of small motor.

Fig. 78 is another form of chafing dish. This type is manufactured by the Simplex Electric Heating Company, of Cambridge, Mass. Fig. 79 represents a household size of coffee urn, also manufactured by the Simplex Company.

Fig. 80 is a very handsome design, colonial pattern, of coffee urn, in suitable size for the home, manufactured by Landers, Frary and Clark, New Britain, Conn. Fig. 81 represents the Universal Thermo-cell sad iron, also manufactured by Landers, Frary and Clark. This iron is made with a special appliance for heating curling tongs.

Fig. 82 is another type of electric cooker manufactured by the Berkeley Electric Cooker Company, Berkeley, Cal.

Fig. 83 is the well-known Sturtevant portable cleaner. It is widely used throughout Canadian territory, where its excellent merits have long been recognized.

New Line of Magnetic Switches

A new line of magnetic switches has recently been introduced by the Cutler-Hammer Manufacturing Company, of Milwaukee. The magnetic lockout switch is a type of series wound accelerating switch that has a number of features claimed to be of particular advantage and importance. The sealing pull, and consequently, the contact pressures of earlier types of series-wound switches are limited because a part of their magnetic circuit is necessarily of restricted area. As the new magnetic lock-out switch has no such restricted area in its magnetic circuit the sealing pull is equal to that of

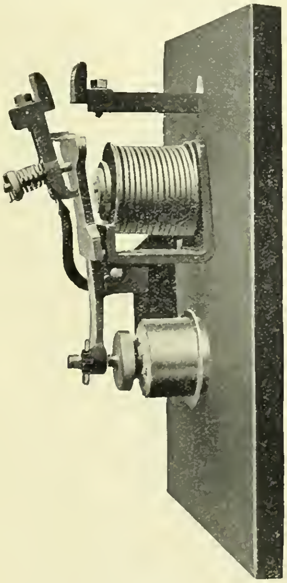


Fig. 1—New Cutler-Hammer magnetic lock-out switch.

the shunt coil operated switch of the same capacity thus permitting higher contact pressures and greater "follow-up" on contacts to allow for wear. Tests made to determine the relative contact pressures of these new magnetic lock-out switches and the single coil series switches of the restricted area type showed that that of the former was 60 per cent. greater than that of the latter. The Cutler-Hammer magnetic lock-out switch has the characteristic of remaining open when the current passing through its windings exceeds a pre-determined and adjustable value, and when the current falls below this value the switches close. The same contacts, the same "follow-up" and the same auxiliary contacts are used as are employed on shunt coil operated magnetic switches of the same capacity, a feature heretofore not to

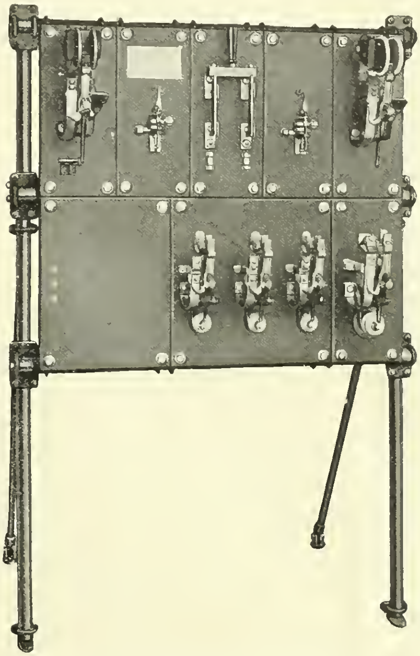


Fig.—2—The four accelerating switches mounted on the lower part of this 75 h.p. 230 volt D.C. panel are of the new magnetic lock-out type.

be found in other lines of switches. On the 100 ampere switches, the arcing contacts are also the current carrying contacts. For the larger size switches laminated brush contacts carry the current, and auxiliary arcing contacts are provided.

The construction of this line of magnetic switches is of the clapper form. The series-wound operating coil of the magnetic lock-out switches is divided into two parts, the upper bar wound, and the lower consisting of copper and asbestos ribbon. The upper section of the coil tends to close the switch and the other to hold it open. These switches are made up as single units, and numbers can be assembled according to the number of steps of resistance used in the motor circuit in starting. The illustration, figure 2, shows four of these accelerating switches on a 75 h.p., 230 volt panel. Cutler-Hammer d.c. magnetic switches that have been furnished for the past several years have been of the clapper type in the smaller sizes, while the larger sizes have been of the contactor type. At the time of bringing out these new magnetic lock-out switches, the shunt switches were re-designed so as to make them all of the clapper type. The advantages of the clapper type switches lie in its greater arc-rupturing capacity, longer life of the contacts, more rapid operation, easier access to parts subject to inspection and repair, and the possibility of interchanging parts with the magnetic lock-out type switches. The new line of magnetic switches is made in 11 sizes and types ranging in capacities from 50 to 3600 amperes.

Increase Your Christmas Trade

Every electrical dealer and central station manager in Canada should be using super-human efforts these days, devising ways and means of bringing the Christmas purchasing business his way. People everywhere are going to buy presents as they always have done. If there will be any difference this year it will be in favor of the electrical gift—for practical ideas will rule. What are you doing to direct buying to your store? You see how the various other retailers are straining every nerve to get the crowd and their money. Are you a willing onlooker or are you in the race yourself?

There are both useless and effective methods of going after this business (generally about equally expensive) and we take the liberty of suggesting one or two that we know have proven very effective; and we believe will do so again many times during the next month. The man who uses the most effective means will be the man who gets more business. The others will get less. Are you going to get more or less than a year ago?

A prospective purchaser of Christmas gifts, in a fair sized Ontario town, who receives numerous letters during the day, was recently the recipient of one outlined with an attractive, suggestive, Christmas border of holly and poinsettia in green, black and red. He paid no special attention to it at first, but during the morning its brightness attracted his eye again so that he singled it out from the pile and read it a second time. During the day he did this instinctively a number of times and he showed it to the various men and women in the store. Finally he folded it up carefully and carried it home to show the members of his household, for the matter of the letter referred to the purchase of Christmas presents suitable for the home.

See what this one letter had accomplished. It had reached every member of the store's staff. It had also reached one household in person and started favorable comment, at least, in a number of others. It had started all these people thinking along the line suggested in the letter, namely, "make your Christmas present selections from the electric store." In the minds of all these people the idea of household electrical appliances was inseparably associated with a merry, bright, happy Christmas. Electric radiators were radiating good cheer, electric kettles were singing the song of the Cricket on the Hearth, percolators and samovars were diffusing the fragrance of the holly and the mistletoe.

That was good advertising.

A similar idea, not so effective, but still by comparison with the ordinary letter a very satisfactory means of attracting attention, is the use of a Christmas stamp bordered in holly or something equally appropriate. This, of course, lacks the attractive color effects that may be had on prepared letter paper, but colored ink may be used to relieve the dullness of the body of the letter. Another suggestion is to use red ink.

Having attracted the reader then with some such idea as one of those mentioned above, it remains now to drive home the value of electrical devices as Christmas presents by a well worded, comprehensive, convincing letter setting forth their claims for attention. Their general utility, moderate cost, attractive appearance, long life, suitability for every man, woman and child of whatever age or whatever circumstances in life should be pointed out. Invite inspection and before they come, make sure that you have the most attractive display in town (which is easily possible, as electrical equipment lends itself admirably for decorative purposes). When your visitors arrive ensure them proper demonstration and make them comfortable and in as far as possible, happy so they will associate these qualities with electrical goods. Send them away convinced, as you can, that nothing else combines, in such a high grade, the qualities of usefulness, luxuriousness and general attractiveness.

Merely as a suggestion, we are reproducing a sample letter herewith and such a letter as, changed to suit local requirements and tastes, would, we believe, prove a splendid business getter this season. Try it. Remember that Christmas buying is a big order. Dealers in other lines have found it well worth while going after, stronger and stronger, each year. It is time the electrical gift should take the prominent place in Christmas buying that it justly deserves. It will if you do your share. Incidentally you will reap the benefit in a nice little addition to your Christmas income.

Licensing Electrical Contractors

The Hydro-electric Power Commission of Ontario are moving in the right direction, in that they are taking steps to ascertain the consensus of opinion among people now engaged in electrical work as to the advisability of introducing legislation requiring that only licensed electricians shall install wiring, and that only approved material shall be sold.

At the present time the man who requires an electrical installation of any kind is greatly handicapped in making his choice of an electrician. He probably realizes that there are good and bad as in all other lines, but he has no basis on which to form a judgment. If a contractor could show a license, however, it would be some indication of his fitness to undertake the work, though, of course, it would not give any idea of his comparative ability. It would, further, eliminate a large number of today's so-called electrical contractors, whose knowledge and experience in the electrical business have generally been gained through a brief period of dealing in electrical supplies.

The following letter has just been sent out by the Commission, as a feeler, to Ontario electrical contractors. It would almost appear to be a superfluous precaution, as reliable contractors will assuredly unanimously endorse it. We hope it will be followed by prompt legislation in the province of Ontario and the other provinces of our Dominion.

Dear Sirs:—

The introduction of the Hydro-electric Power Commission's Rules and Regulations governing inside wiring has now been effected and many electrical inspectors are already appointed and such appointments will continue to be made until electrical inspection is enforced as far as practicable throughout the province. It is a well-known fact, however, not only in Canada, but all over the American continent, that one of the greatest evils which confront properly qualified electrical workers and contractors as well as manufacturers and dealers in electric supplies is the competition from unqualified, inexperienced wiremen who are, owing to the absence of laws bearing on the subject, at liberty to undertake electrical wiring or the sale of electrical apparatus or supplies utterly regardless of their efficiency or safety.

A large amount of this sort of work and the sale of such material is more or less effectually prevented where there is electrical inspection, but even in such places the inspector is continually confronted with such conditions. In many of the American cities and districts legislation is now being introduced permitting only licensed electricians to install wiring or approved material to be sold. It has been suggested from time to time that such legislation be enacted in this province, and before taking any further steps in the matter and suggesting any amendments to the present Act, it is the wish of the Commission to ascertain from people now engaged in electrical work the consensus of opinion as to the advisability of adopting measures similar to those now being introduced in other countries requiring that only licensed electricians be permitted to perform electrical work, and that only material which bears the stamp of approval be permitted to be sold or used in the province. We therefore ask for your careful consideration of this question and would appreciate your comments or suggestions.

Yours truly,

Chief Engineer.

THE ELECTRIC STORE

Smithville, December 1st, 1914.

Mr. John Jones,
Smithville, Ont.

Dear Sir:—

A Merry Christmas!

In these serious times it behooves us all to plan beforehand that our Christmas giving may represent the sentiment which actuates the whole British nation to-day,—co-operation and brotherhood. The spirit of "Help one another" will be stronger this Christmastide than ever before. This will be evidenced in our gifts, which must, therefore, take into consideration, first and foremost, the circumstances of the recipients and their value to them. In former years we have sought for appropriate presents; this year they must not only be appropriate,—they must also be useful.

Electrical devices of every kind meet these requirements.

We do not claim to have a monopoly of all the Christmas presents in town that are appropriate and useful. We do claim, however, that these two qualities are particularly prominent in **all** our devices. We claim, further, that our varied list contains something that will bring a glow of pleasure to the cheeks of every boy and girl, man and woman among your list of Christmas friends. And last, it will be an ever-recurring pleasure, for the modern electric appliance is practically indestructible.

Think this over,—appropriateness, usefulness, everybody wants it, lasts almost indefinitely.

We have a carefully selected stock at prices to suit the present financial conditions,—electric irons, toasters, percolators, water heaters, vacuum cleaners, chafing dishes, flash lights, foot warmers, portable heaters, etc., in addition to sundry smaller items more in the nature of novelties and specially suitable for your younger friends. Come in and look them over. We shall be pleased to show them, to answer all your questions, to demonstrate them, and, if they please you, to set them aside for you till Christmas Eve.

Remember the watch-word this year is "useful." We have it, personified. Give us a chance to prove it,—to-day or to-morrow at latest. We are convinced,—we will convince you.

Yours very truly,
James Brown,
Manager.

New Arrow-E Socket

In the line with the development in large unit lighting, the Arrow Electric Company has brought out various types of Sockets and Receptacles for Mogul base lamps, the latest additions to the line being illustrated in the Catalogue Supplement recently distributed. One of these sockets is shown in the accompanying illustration. All of the various types are designed for use with "Type C" high-efficiency lamps,

Arrow-E Mogul.

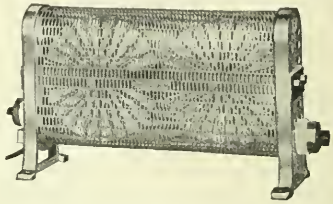
attention having been paid to the particular conditions governing the use of these lamps. The new porcelain fixture sockets may be used with fixtures which have already been designed for the earlier type of brass shell Mogul socket, the over-all length being the same in both types. A special sealing compound is used which hardens with the application of heat. Northern Electric Company are Canadian agents.

New Line of Polyphase Induction Motors

The Robbins & Myers Company, Springfield, O., have just recently completed the development of an entirely new line of polyphase induction motors, ranging in size from ¼ to 7½ horse-power inclusive. They are supplied for operation on two or three-phase, 110, 220, 440 and 550 volt circuits of all commercial frequencies. The frame of these motors consists of a cast-iron skeleton type shell which supports the stator; this exposes the stator core to the air and gives thorough ventilation. The end heads are cast separately from the frame; they are machined to fit the frame and are attached by four machine screws. Exceptionally large bearings and oil reservoirs are provided. The bearings are grooved to distribute the lubricant and are made absolutely dust-proof. The stator is built up of soft, annealed steel laminations which are held together by bolts. The rotor is the squirrel cage type. The core is built up of steel laminations which are keyed to a cast iron spider. The rotor bars are connected to the end rings which are recessed to fit them, by double riveting and soldering. The terminals are brought out through holes in the frame which are suitably bushed with insulating material. Each motor is regularly furnished with a sliding base and cast iron pulley. They can also be supplied with idler pulley attachments or back gears if so desired.

The Economic

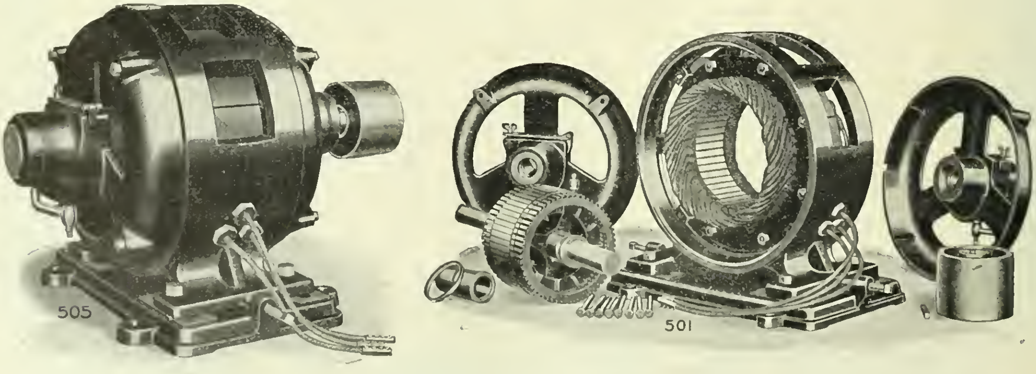
A new type of heater called the "Economic" has been put on the market by the Canadian General Electric Company. Its construction is such that with ordinary use it is claimed it will last a lifetime. It is produced in several different types. The portable single disc radiator consuming 660 watts is admirably adapted for the heating of small



rooms. In addition to this, two and three disc radiators are supplied; the two-disc consuming a maximum of 1,000 or 1,500 watts as required, and the three-disc consumting 2,100 watts. These are also supplied with heat control switches. It will be interesting to note also that this type of heater has proven itself very efficient for the heating of street cars.

A New Electric Coffee Pot

The two-pint coffee pot is a recent addition to the line of C. G. E. coffee percolators. It is especially suited to small families where the three-pint pot may be considered too large. It has an exceptionally low operating cost as it consumes but 350 watts. This device uses either hot or cold water and will produce excellent coffee in from 10 to 15 minutes when started with hot water and in from 20 to 25 minutes when started with cold water. When starting with cold water, percolation will begin in about two minutes after the current is turned on. At least one-half pint of water should always be used in order to make the pump operative. All parts of the coffee pot are very simple in construction and may be easily and readily removed for cleaning. The



Polyphase Induction Motors, new line—Exploded view shown on right.

coffee biggin is permanently attached to the pump tube. It is made of heavy copper with nickel finish. Because of its substantial cross section of metal it is not readily dented and affords a handsome serviceable device.

Conduit Box Strap

The question often arises as to how certain types of receptacles can be attached to some of the modern types of outlet boxes. This appears to be applicable to the pancake type of box and to the deep box, with a cover and without lugs or ears. To meet this condition a very simple little device has been designed in two styles by Pass & Seymour, Inc., Solvay, N.Y. They call it a conduit box strap. It is made in two sizes or styles, so as to permit its use in a

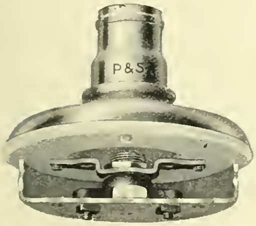


Fig. 1.

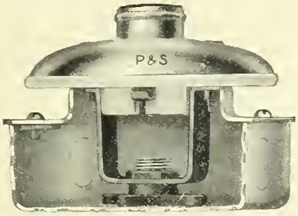


Fig. 2.

Fig. 3.

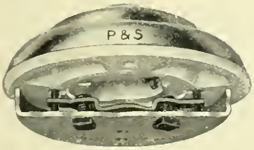


Fig. 5.

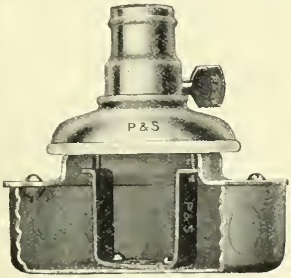


Fig. 4.

deep or shallow box. Either style may be used with or without the fixture stud. Figs. 1 and 2 show the shallow and deep boxes; in each instance the strap is attached to the fixture stud. Fig. 3 illustrates the use of the strap, not only with the fixture stud, but on a BX type of box. Figs. 4 and 5 show the use of the strap without the use of the fixture stud.

Novel and Effective

The Consolidated Gas, Electric Light & Power Company, of Baltimore, have hit upon a novel idea of demonstrating the use of electrical appliances. This takes the form of an electric motor car supplied with a battery of 60 cells and three 150 ft. cords. The car is brought up alongside any house, the cords run into the house and they have immediately at hand the means for demonstrating lighting fixtures, heating fixtures, heating devices, vacuum cleaners or other household appliances. One of the big advantages of this equipment is that it is applicable to the unwired house, and is often a sufficient argument in favor of having the house wired up. On account of the unique idea, too, which is further emphasized by large signs placed on the car, the whole neighborhood is apprised of the nature of the demonstration. This usually results in a number of demonstrations being given on the same street. It is claimed that this has been a most effective means of assisting the wiring and appliance department of this company.

Escher Wyss & Company, have been awarded the contract for a 12,000 kw., Turbo-Generator set for the Corporation of Leeds, England. This contract had previously been awarded to a German firm but was, after declaration of war, awarded to Escher Wyss & Company, with Siemens Generator 3-phase, 50-cycles, 6,750 volts. The speed of the set is 1,500 r.p.m.

Trade Publications

Worm-gear Chain-blocks—Bulletin issued by the Herbert Morris Crane & Hoist Company, Toronto, describing and illustrating the Morris worm-gear chain-blocks.

Transformers & Meters—Leaflets issued by the Ferranti Electric Company, Limited, Toronto. Leaflet T8 illustrates and describe pole-type transformers; leaflet T9 illustrates power transformers and leaflet T10 describes in considerable detail, with illustrations, Ferranti single phase pre-payment meters.

Electrical Catalogue—Small booklet by the MacGovern Company, 114 Liberty Street, New York City, dealing with contractors' materials, air compressors, hoists, steam shovels, car equipment, etc., carried in stock by this company.

Water Softening—Leaflet number 17, issued by the Canadian Allis-Chalmers Company, Limited, Toronto, describing the Sorge-Cochrane hot process system of water softening, with illustrations.

Textile Machinery—Bulletin number 48015, issued by the Canadian General Electric Company, Limited, describing and illustrating a transformer specially designed for operating electric stop-motion of textile machinery.

Current News and Notes

Bolton, Ont.

The hydro line is being extended from Woodbridge north to Bolton, and it is expected this village will be lighted by Niagara power in time for Christmas.

Brantford, Ont.

The Township Council will proceed in the near future to supply Grandview, Parkdale and Echo Place with hydro power and light.

Brampton, Ont.

The Chinguacousy Township Council have authorized the town of Brampton to look after the installation and operation of their electric light and power business.

Grand Forks, B.C.

This district is shipping another 10,000 lot of poles to the Hydro-electric Power Commission of Ontario.

London, Ont.

The method of charging by the local Hydro Commission in London has been different from other cities in the hydro area, in that London consumers have been given the option between the standard system adopted by the Commission and a straight meter rate. It is understood that after December 1st the straight meter rate will be discarded and London will fall in line with the other municipalities.

Lambeth, Ont.

A by-law was submitted on November 28th asking the authority of the ratepayers to make an agreement with the Hydro-electric Power Commission of Ontario for the supply of power.

Mount Brydges, Ont.

A hydro transmission line has been completed to this point, and it is expected that power and light service will be commenced about December 1st.

Mount Forest, Ont.

A by-law will be submitted on January 1st, authorizing the Town Council to make terms with the Hydro-electric Power Commission of Ontario for a supply of power.

Montreal, Que.

The Grand Trunk Pacific telegraphs between Winnipeg and Prince Rupert, a distance of 1,279 miles, were linked up and communication opened on November 18. This will give a telegraph service to numerous places which have hitherto been without this facility.

The Westmount Council have completed a further section of the improved lighting system designed by Mr. G. W. Thompson. Fifty-nine standard lamps have been put into service on Sherbrooke Street and Wood Avenue, and later other thoroughfares will be dealt with.

Port Arthur, Ont.

The Report of the Commissioner of Utilities of the city of Port Arthur for the quarter ending September 30th, 1914, showed a gross revenue of $39,894.27; operating expenses $22,027.07; fixed charges $10,240.84. This leaves a net profit of $7,626.36. The total net gain for the first nine months of the year is $40,929.58. According to a recent statement published by the Hydro-electric Power Commission, Port Arthur would appear to have made the best showing of any of the municipalities connected with the Hydro-electric Power Commission.

Regina, Sask.

The operation returns of the Municipal Street Railway System of Regina for the week ending November 7th were as follows: revenue $3,051.75; passengers carried 70,485. Corresponding figures for week ending November 14 were $2,999.30 and 72,963.

Toronto, Ont.

The York Township Council has authorized the Toronto Hydro-electric Commission to install street lights in Swansea and Runnymede at an average yearly maintenance cost of about $20 per light. The contract is for ten years, but expires if and when this district is annexed to the city.

Vancouver, B.C.

The Farmers' Telephone Company, Limited, is in liquidation.

The Vanderhoof Power Company, Victoria, B.C., have made application for a license to take 100 second feet of water from Stoney Creek and store it for power purposes.

Williamsburg, Ont.

A by-law was carried on November 17th authorizing the expenditure of $2,750 on an electrical distributing system to be connected up with the Hydro-electric Power Commission of Ontario's general distribution plant.

The Dawson, Yukon, authorities are said to be planning to establish a municipal electric light and telephone plant, estimated to cost $165,000.

Mr. Colin Kemp, B.Sc., and Mr. L. S. Eaton, B.Sc., have been appointed Sessional Lecturers in Electrical Engineering, at McGill University, with Messrs. H. A. Chambers and G. L. Stewart demonstrators for the present session.

Mr. F. Holmes, works manager of the Hart Accumulator Company, Limited, London, Eng., is on a visit to Canada, in connection with the plant which has been erected at St. Johns, P.Q., by the Canadian Hart Accumulator Company, of which Mr. C. W. Knighton is manager.

Escher Wyss & Company, of Montreal, have been awarded the contract for two 2,250 h.p. water wheels with accessories by The Hydro-Electric Power Commission of Ontario for their new hydro-electric power plant at Eugenia Falls. These wheels work under a head of 540 feet running at 900 r.p.m.

Electrical News

Generation, Transmission and Application of Electricity

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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The Electrical Contractor and the Central Station

Little by little the electrical dealer and the electrical contractor are winning recognition as necessary units in the proper development of the electrical industry. Slowly, but surely, the central station is withdrawing to its own legitimate field, the manufacture and sale of electric current. The handling of electrical appliances and supplies is evidently and logically a business in itself quite as much as is the installation of wiring and conduit.

The formerly unanswerable argument of the central stations that they are driven in self-defence to wire houses and sell devices because otherwise this part of the industry would be neglected and the demand for their electric current supply would be thereby curtailed, is now being answered by the electrical dealers and contractors themselves, who are developing business methods, showing signs of capital resources, and giving other indications of being in a position to carry on this work, if the central stations will drop out.

Two important considerations have to be considered in connection with the situation during the past. The first has been the unsatisfactory status of a very large number of so-called dealers and contractors. These could not be depended on to build up the business as the central station felt it should and could be built up. The second consideration is the natural outgrowth of this. The central station's demand is regulated to a very large extent by the activity of the dealers and the contractors in his constituency. If these fail to do their part, the number of installations and sales of appliances will be smaller than, under vigorous campaigning, they ought to be, and the central station is the direct loser.

The recent action of the Hydro-electric Power Commission of Ontario in sending out letters to the various contractors to learn their opinions on the advisability of licensing all electrical contractors, is a step in the right direction. What we want is a more responsible class both of dealer and contractor. There is little doubt that, as soon as the central station recognizes the ability of the dealer and contractor to develop his constituency by encouraging the use and prosecuting the sale of every kind of electric current consuming device, then the central station will willingly hand over this part of the business to the dealer and contractor and confine himself to his proper sphere—generation and delivery.

For the best results, the closest co-operation will be necessary between these three classes. In the United States a very active move has been made towards co-operation and the electrical contractors have a very strong national association. In Canada nothing of the sort exists, except at local points, and the evident need is a number of provincial associations which shall possibly eventually be merged into a Dominion association. Up to the present time, with the chaotic condition of electrical contracting all over the Dominion, an association appears to have been an impossibility, but with improved conditions, with electrical contractors realizing more fully the importance of their work and with the general recognition on the part of the public that electrical contracting is a profession, the possibilities of a strong association appear to be greatly improved.

Mr. Geo. E. Shepherd, an electrical engineer of recognized ability, who has thrown in his lot with the electrical contractors, writes an interesting article in a recent issue of the National Electrical Contractor on the relationship between the dealer, contractor and central station, expressing, of course, the contractor's point of view. We believe Mr. Shepherd is inclined to credit the central station with an undue desire to encroach upon the legitimate field of the contractor, which is not borne out by the facts. As stated above, we are satisfied that, as soon as the electrical contractor demonstrates his ability to take up this work himself, the central station will be only too pleased to lay it down. Some abstracts from this interesting paper appear in other pages of this issue.

International Engineering Congress

The American Institute of Electrical Engineers have made a further announcement relating to the International Engineering Congress, which will be held in San Francisco, California, in connection with the Panama-Pacific International Exposition, on September 20-25, 1915. Since the outbreak of the European War, considerable pressure has been brought to bear by German sympathizers to have this congress postponed, but without success.

The papers to be presented before the Congress will cover the general field of engineering as indicated in the list of volumes given under the heading "Transactions." These papers will treat the topics comprehensively and with special reference to important lines of progress during the past decade, and will cover approved present practice and lines of future development. It is intended that each paper shall be accompanied by a bibliography of the subject.

Since the development of the situation in Europe, it has been necessary to consider the possible modification of the original plans of the Congress. Originally, about 290 papers were contemplated, and the Committee of Management now state that of these about 220 are either definitely promised or are well assured. Among these are contributions from England, Spain, Sweden, Holland, Canada, India, Italy, China, Japan, Australia, and various South American countries. The remainder, apportioned among the nations in the present European war zone, are uncertain, and it must be expected that some of them will not be secured. It is believed, however,

that certain other papers may be substituted for these, and that the Congress work will be carried out with a minimum of change. Timely notice will be given regarding any changes in detail.

Special efforts will be made to secure discussions, carefully prepared in advance for presentation with the papers, and opportunity for oral discussion will be afforded at the various sessions of the Congress. Discussions may be submitted in any language, at the choice of the writer, and, if in other than English, will be translated for publication.

It is the intention to publish the Transactions in ten 6 by 9-in. volumes of about 500 pages each, with one smaller volume which will contain the reports of the business meetings of the Congress, together with a title and author index and a brief digest of each paper. The following is a schedule of the volumes:

Index and Digest.—General proceedings, indexes, and digests.

Volume I.—The Panama Canal (24 topics).

Volume II.—Waterways (6 topics).
Irrigation (11 topics).

Volume III.—Railways (7 topics).

Volume IV.—Municipal Engineering (8 topics).

Volume V.—Materials of Engineering Construction (20 topics).

Volumes VI. and VII.—Mechanical Engineering (28 topics). Electrical Engineering (8 topics).

Volume VIII.—Mining Engineering (10 topics).
Metallurgy (10 topics).

Volume IX.—Naval Architecture and Marine Engineering (19 topics).

Volume X.—Miscellaneous.

The general fee for membership in the congress is $5, which will entitle the member to receive the index volume and any single volume of the transactions which he may select, together with the right of participation in all general activities and privileges of the congress. Other volumes may be secured at prices ranging according to the quantity taken. For $30 one may secure a complete list of publications bound in cloth.

Prince Rupert Plant Ready to Operate

In 1911 the citizens of Prince Rupert passed a by-law to raise money for the purpose of installing a combined gravity water supply and hydro-electric development. Prior to March of the present year nothing had been done on the electrical end of the project and the water system was only partially completed. The council, at this time, ordered the completion of the combined undertaking. Owing to a landslide which had taken place on the pipe line right-of-way it was necessary to abandon the original surveys and lay out a comparatively new route for the pipe line. The work was taken in hand by the city engineer and the city electrical superintendent Mr. T. C. Duncan, E.E. Contracts were let for the pipe to Gerald Lomer, Limited, the specials to the Mannesmann Tube Company, the turbine to the Canadian Allis-Chalmers and the generator and electrical equipment to the Canadian General Electric Company. The transmission line material was supplied by the Northern Electric Company.

A concrete dam has been constructed across the mouth of the creek which drains Woodworth Lake, about seven miles from the city. This lake has an area of 454 acres and will provide ample storage to carry the plant over the dry season. A 45-inch lap welded steel pipe has been laid between the dam and the power house, a distance of 7,800 ft., an 18-inch branch of the same class of pipe being taken off at a point immediately above the power house and laid to connect up with a cast-iron pipe crossing the passage between the mainland and Kaien Island on which Prince Rupert is situated, this pipe being 13,000 ft. in length. The whole of the work has been carried out by city labor.

The generating plant installed consists of a 1,650 h.p. turbine and a 1,125 kv.a., 4,400 volt generator. The transmission line is built on wood poles with the exception of the crossing from the mainland to the island, a distance of 925 ft. in which two steel towers are employed. The power is transmitted at the machine voltage, extra equipment being installed at our city steam plant which will now be used as a sub-station and auxiliary plant. The system employed in the city distribution lines is 3-phase, 4-wire, with 2,500 volts between primary and neutral. We use standard single-phase transformers and supply all lighting and single-phase motors at 115 volts and 3-phase power at 220 volts.

The work is practically completed. Testing out of the pipes and machines is now being carried out and it is expected that operation will commence in a few days.

Power Generated in Canada

The Commission of Conservation of Canada is endeavoring to make a complete inventory of the amount and kind of power used at every point in Canada, and to this end question blanks are being distributed. This is a most important undertaking, and one that should receive the co-operation of every power user. One of the difficulties will be that the list of power users in the hands of the Commission may not be, and likely is not, complete. Any power user who gets one of these blanks would, therefore, be materially assisting in this valuable work, if he would forward to the Commission the names of other power users in his district and especially if it should come to his attention that any of these are not on the government list.

Possibly some readers of the Electrical News who may not receive a copy from the Commission are in a position to supply information. With this in mind, we are reproducing the letter and accompanying blank form in full. The regular blank can be had on application to the Commission or the form herewith may even be torn out and forwarded, properly filled in, to the secretary at Ottawa. The main idea we ask our readers to keep in mind, however, is that the Commission needs the help of every individual power user to make this list complete, otherwise the effort will lose much of its value. The letter follows:—

Ottawa, November 4th, 1914.

Dear Sir:—

The Commission of Conservation is compiling data respecting power used in Canada. You doubtless recognize the importance of such an inventory to power users and to manufacturers generally, and I trust you will furnish me with the following information regarding the power used at your plant at as early a date as possible. The information may be inserted on the blank spaces opposite the questions on this sheet and, if returned in the enclosed envelope, will come post-free. While the questions asked are drafted so as to include the different kinds of power used, nevertheless should they not cover fully **the kind of power and manner of application at your plant**, I shall be obliged if you will supply the additional information under **Remarks.**

1. (a) Name of firm ....
   (b) Place where located ....
   (c) Products manufactured ....
2. Motive Power Used.
   (a) Water-power, horse-power used ....
   Number of days used per year ....
   (b) Electric power, horse-power used ....
   Number of days used per year ....
   (c) Steam-power, horse-power used ....
   Number of days used per year ....
   (d) Gas engine, horse-power used ....
   Number of days used per year ....
   (e) Oil engine, horse-power used ....
   Number of days used per year ....
3. Water-Power.

If water-power is used and you generate your own power, please state:—

(a) Head utilized ... ... ft. and name of river ... ...
(b) Number, type and horse-power of each water-wheel
... ...
(c) Amount of surplus power at lowest stage of stream
... ...
(d) Amount of deficiency of power at lowest stage of stream ... ...
(e) Approximate cost of power per horse-power per year
... ...

4. Electric Power.
If you generate your own power, please state:—
(a) Quantity generated ... ...
(b) Approximate cost per horse-power per year ... ...
If you purchase electric power, please state:—
(a) The number of horse-power purchased ... ...
(b) Approximate price paid for power ... ...
(c) Name and address of company from whom purchesed
... ...
State number of motors used at your plant and horse-power of each ... ...

5. Steam-Power.
If steam-power is used, state:—
(a) Quantity and kind of coal used per year ... ... and cost per ton ... ...
(b) Quantity and kind of wood used per year ... ... and cost per cord ... ...
(c) Quantity of other fuel used and price ... ...
(d) Types of boilers used (return tubular, flue or water-tube), number and horse-power of each ... ...
(e) Types of steam engines used (simple, compound, compound condensing or turbine), and horse-power of each ... ...
... ...
(f) Approximate cost per horse-power of power generated
... ...

6. Gas Power.
If gas engine is used, do you make your own gas or are you supplied by a local company ... ...
What rate do you pay per 1,000 cu. ft. ... ...
If producer gas is used, state:—
(a) Kind and price of coal per ton ... ... and amount used per year ... ...
(b) Type of producer (suction, down draft, etc.) ... ...
(c) Approximate cost of power per horse-power per year
... ...
(d) Does the plant give satisfaction ... ...

7. Oil Engine.
If gasoline or oil engine is used, state:—
(a) Price of gasoline per gallon ... ... and amount used per year ... ...
(b) Kind of oil used ... ... price per gallon ... ... amount used per year ... ...
(c) Approximate cost of power per horse-power year ...
... ...
(d) Does the engine give satisfaction ... ...
Remarks: ... ...
... ...

If you desire that any information be considered as confidential, kindly indicate such portion.

Yours truly,
James White,
Assistant to Chairman.

Still Lower Rates

The Public Utilities Commission has inaugurated new rates in London, Ontario, following the recommendation of the Hydro-electric Power Commission of Ontario. Apparently these are the lowest rates given to any municipality in the Hydro area. Up to the present time London has given an optional flat rate as well as the regular rate according to the commission's standardized plan. The flat rate is now done away with. The rates in effect from December 1st, 1914, are as follows:—

Domestic lighting—3 cents per 100 square feet of floor space with a minimum of 1,200 feet, and a maximum of 2,500 feet, plus a meter rate of 2 cents per kw. hour. A 10 per cent. discount is allowed for prompt payment.

Commercial lighting—5 cents per kw. hour for the first 30 hours use of installed capacity, 2 cents per kw. hour for the next 70 hours use and 3/5 of a cent beyond that amount. Discount 10 per cent.

How Many More Lives?

Winnipeg, December 1st, 1914.

The Editor,
Electrical News.

Sir,—I have read with much interest your editorials on the above subject, and heartily commend your action in drawing attention to the matter. I fully thought the various operating companies and municipalities in Canada would show considerable activity following the recent decision of the Quebec courts, wherein the supply company was assessed with some $26,000 damages and costs for neglecting to ground their secondaries. As to your suggestion that the matter should be discussed by the engineering bodies—that, to my mind is superfluous—no engineer of standing, I venture to say, can be found to-day to discourage the grounding of low tension secondaries. What is the greatest surprise to me, is that the Hydro-electric Power Commission is displaying such apparent indifference in this matter. In their admirable set of rules—Section E, page 113—the grounding is made mandatory, and considering the fact that these rules were apparently drawn up and adopted with the idea of paying greater attention to the question of life hazard than the National Code devoted to the subject, the Commission's apathy is, to say the least, remarkable. I also fail to understand the lack of interest displayed by the Fire Underwriters—surely this body, in view of the strenuous fight they put up in Quebec in the above quoted case, might be expected to take some part in bringing pressure to bear on the authorities with a view to enforcing the provisions of the "Code" in this respect. No doubt the war will be used as an excuse by most people for delaying action, but if the urgency of the matter could be realized, any governing body should be prepared to order this work to be undertaken in the public interest. One of the leading professors of electrical engineering in Canada recently expressed his opinion on the matter, and it was to this effect: "any company or corporation that neglected to ground its secondaries was guilty of criminal negligence." How many more lives will have to be sacrificed before this is realized? Probably a legal action or two decided against the wire-owning corporations will be the quickest way to arouse them as to their obligation to the public in this respect.

Yours truly,
(Signed) H. M. Smith.

Our Christmas Duty

The Electrical News wishes its readers the best of Christmas cheer and happiness that is possible under the existing conditions of cruel and barbarous warfare, into which many of our own loved ones have been drawn. We cannot hope to be merry or happy in the usual Christmas sense, but we can indeed be truly grateful for the encouraging tone of the leaders of our armies and confident of an ultimate successful issue of the war: confident, too, that our trade conditions are already past their worst and that, with the ending of the war, Canadian industries are surely due for a rebound into unprecedented activity.

Our duty plainly is to see to it this Christmas that no citizen of Canada lacks the means of being grateful. In ministering to those less fortunate, we may in part forget the hideous cause of much of our misfortune.

Economics of Municipal Plants

By Mr. H. K. Dutcher, before the recent convention of British Columbia Municipalities

There seems now a general tendency on the part of the towns and cities throughout the Dominion to have municipal electric power plant and distribution systems in preference to having these systems controlled and operated by corporations, and while there has been in the past a pronounced weakness in the management of some municipal plants, a marked improvement is noted in this respect where the control of such systems is placed under a commission or board of commissioners. In fact, the recent annual reports on the operations of almost all the municipal systems in Western Canada would indicate that some of these plants are operated with a degree of thoroughness in cost keeping and commercial development which compares favorably with the best corporation plant systems. Where the operation of a company system is subject to severe criticism in the matter of rates or service of the systems it is fair to state that in some cases the condemnation of the companies is not always justified where investments have been made in the face of the most discouraging conditions of construction with plant becoming obsolete before its time by reason of the experimental stage of the science, and the pioneer period of development which has marked the growth of western towns. On the other hand where the rates are unreasonably high, and it is inconvenient or not possible to take over a system under municipal control, it is sometimes possible to obtain the desired reduction in rates by introducing competition at a reasonable expenditure in a municipal plant designed for enlargement from time to time as may appear desirable to extend the field of competition.

Typical Examples

For example, the City of Montreal is served with electric light, power and electric railway systems by two strong companies, which control practically all of the available water powers near the city. Through the condition of early combination, watered stock and reorganizations, the dividend returns on stock are only ordinary, notwithstanding the cheap source of power and high rates to the consumer. About ten years ago the City of Westmount, a suburb of Montreal, established a small municipal steam plant to compete with the company within its limits, with the result that the people in Westmount were able to obtain electric light and power from either the municipal power plant or the company system at about half the rates charged to consumers in Montreal.

In Ontario the Hydro-electric Commission was formed in 1906 to carry out a scheme of cheap power distribution to the towns of the lower peninsula, and the work of this commission is rapidly spreading over the more populous section of the Province with the result that the Hydro-electric resources of the Province, including the development at Niagara, are affording cheap power for the numerous towns within range of the system to an extent which is now fully appreciated by the consumer and the annual reports of this commission indicate the remarkable results obtained and the efficiency of their work.

The City of Winnipeg a few years ago undertook the construction of a hydro-electric plant to compete with the company plant then serving the consumers, and by the competition of the municipal plant the ordinary rates of electric light have been reduced from 20c per kw.h. to 3c per kw.h., this rate being about the lowest for any city in America.

Assuming even a company rate of 12c per kw.h., and a total consumption of 30,000,000 kw.h. per year, the reduction to 3c per kw.h. represents a saving to the citizens of over $2,000,000 per year which appears to well warrant the investment of $6,000,000 in the municipal plant.

In the smaller cities of the Middle West where hydro-electric power is not available or economical, the municipal plants generating power by steam or Diesel oil engines are permitting maximum lighting rates of about 7c per kw.h., which rates may be further reduced by the increased demand.

In the case of Calgary the municipal system is supplied with power both from a municipal steam plant and hydro-electric power from the Bow River Power Company, the muncipal plant serving as a reserve and auxiliary supply of power to the water power plant. It enables the city to obtain power in bulk from the company at rates only possible by the possession of the municipal plant; while the prospect of the city obtaining a hydro-electric development of its own will probably place the city in a still better position with respect to power.

Low Rate in Seattle

In British Columbia the municipal plant systems are so far confined to the smaller towns, and the rates are somewhat higher than the rates prevailing in the East and Middle West. On the coast, it is interesting to note that both Seattle and Vancouver are served with hydro-electric power, Seattle having a municipal plant and Vancouver a corporation plant system. In Seattle, however, the maximum rate to the consumer is 6c per kw.h., while the Vancouver rates are about double this charge. But before the city of Seattle entered into competition with the company system the maximum rate there was 20c per kw.h., and when the municipal plant was projected in 1902 the company then reduced its rate to 12c, and finally to the same rate as the city when the plant was placed in operation.

In most cases it will be found that for small towns the annual consumption of power will be from 150 to 200 kw.h. per capita. For example, Vernon requires about 50,000 kw.h. per month, or 600,000 kw.h. per year, of which about 15 per cent. is for street lighting. On the other hand, Kamloops, with a population of about double that of Vernon, requires as much more for the pumping plant and power service.

A combined hydro-electric and steam power plant system is now completed for the city of Kamloops at a total expenditure of nearly half a million dollars. The steam plant was completed last year and is designed to act as a reserve or auxiliary plant and pumping station with initial installation of steam turbines for 2,000 h.p. capacity the fuel to be either coal or oil.

Kamloops Well Supplied

The City of Kamloops has therefore an assured source of cheap power to provide for all requirements well into the future. When studying the present and future needs of the city with respect to electric power, the following facts were noted. The City of Kamloops by reason of its location at the junction of two important rivers and two transcontinental railway systems, was rapidly assuming the position of the Spokane of British Columbia. The need was apparent, however, of cheaper power, and greater agricultural development along both river valleys. With coal of an indifferent quality costing over $4.00 per ton the prospect of cheaper power from a steam plant was not apparent since the expenditure for fuel alone would cost about 1.3 cents per kw.h., or over $30,000, for this year's consumption of power.

Since, however, as is the case of practically all water power plants in Canada where winter conditions are more severe, the steam plant was built as a necessary part of the system to act as a reserve or auxiliary plant. It is, therefore, necessary to include the annual charges on the steam plant. Thus taking the combined plant with a capacity of 4,000 h.p. the total charges are estimated at 58,910.

While very little has yet been done by Vancouver, Victoria and the municipalities surrounding these towns with respect to municipal power plant systems, there has nevertheless been developing a certain amount of interest in this direction and reports have been submitted dealing with the

problem of securing water rights for future power development and undertaking the construction of steam plants to provide for the present requirements and fit in with the future scheme of hydro-electric power.

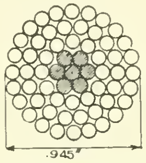
Where a municipality undertakes the responsibility of operating a municipal power plant system it is well to remember that it is better to invest a few thousand dollars in perfecting that system than to lose an equal amount through waste of fuel, supplies, materials, or through mistakes which may have to be remedied at considerable cost. In fact, no matter how well built a plant is, the results obtained will largely depend on the efficiency of the operating staff and the co-operation of all concerned towards establishing that esprit de corps so necessary to the success of any enterprise.

Aluminium Transmission Lines

The table presented herewith makes no claim to being complete, but is a compilation from various sources of the more important hydro-electric undertakings in North America which are employing aluminium cables on their transmission lines. Some features of the table are of particular interest. It will be noted that the longest transmission lines in the world, viz., the Pacific Light and Power Corporation (Los Angeles-Big Creek), the Southern Sierras Power Company (Bishop-San Bernardino), and the Hydro-electric Power Commission of Ontario (Niagara-Windsor), are all using aluminium wholly or in part. It will be observed that seven and nineteen wire cables are the rule. Owing to the fact of the light metal being more flexible than copper, fewer strands are necessary.

Five systems, it will be noted, are trying out the steel centre aluminium cable, in which the tension of the line is carried by a core of high carbon steel wires, around which are laid the aluminium wires. This type of cable can be strung with somewhat smaller sags than straight aluminium and so shorter and cheaper towers can be used. The line tension windage and loading on the towers are increased, however. Columns 9 and 10 of the table are interesting as showing that on no less than fourteen systems spans exceeding 1,000 feet in length are being run with aluminium.

Some idea of the importance of this vigorous young competitor of copper can be obtained by totalling up the weights given in the table. It will be seen that the total in use, or specified, aggregates twenty-four million pounds. Owing to the weight ratio of two to one, the quantity of copper displaced by this aluminium is just forty-eight million pounds. In connection with the Mexican Northern data it



Cross-section of 61 strand cable, correct size—Seven central strands are steel.

should be stated that the figure of 630 tons represents the ultimate total; the line at present under way will have a weight of only 320 tons.

The line cut reproduced herewith represents a cross-section of the Pacific Light & Power Company's 61-strand cable. Of the total number of strands the seven central ones are steel, leaving 54 of aluminium.

Nelson-Vancouver Telephone Service

As the result of a visit paid by British Columbia Telephone Company officials to Nelson some time ago that city is likely to secure telephone connection with Vancouver and other Coast points in the near future. A trial conversation was carried on with Vancouver Exchange via Spokane and Seattle, when the results were so satisfactory that a service will likely be instituted in the not distant future. The test was made by George H. Halse, general manager of the company, and F. C. Bolschweiler, general superintendent. It was also decided to lay a new cable across the West Arm of Kootenay River at Proctor to connect up the company's Nelson-Balfour line with the Dominion Government's line to Kootenay Landing. It is also proposed to connect Nelson and Kaslo by a direct line which will be an extension of the system between Kittos and Balfour, completed about six weeks ago. The service between Nelson and New Denver is also marked for improvement and the line from Rossland to Patterson is to be rebuilt in order to give improved transmission to Grand Forks and other points in the boundary country.

DETAILS OF TRANSMISSION SYSTEMS IN AMERICA USING ALUMINIUM CONDUCTORS.

Country	System	Miles	Volts	Wires	Size C.M.	Strands	Core	Span Stand.	Span Max.	Tons of Alum'm
Alberta	Calgary Power Company	50	50,000	3	133,100	7	Al.			50
British Columbia	Vancouver Island Power	40	40,000	3	133,100		Al.			40
California	Pacific Light & Power	275	150,000	6	605,560	61	St.	660	1700	2480
California	Pacific Gas & Electric	109	110,000	6	267,000		Al.	660	2350	440
California	Pacific Gas & Electric	500	60,000	3	Various	Var.	Al.	125	1500	1000
California	San Joaquin Light & Power	650	(30,000 / 60,000)	3	Various	Var.	Al.	350	1700	800
California	Southern Sierras Power	238	140,000	6	211,600	7	St.	660	1500	700
Connecticut	Conn. Power Company	77	33,000	3	167,800	7	Al.			96
Connecticut	Conn. Power Company	23	33,000	6	105,600	7	Al.			36
Georgia	Cent. Georgia Trans.	34	66,000	6	167,800	7	Al.	550	1100	86
Georgia	Cent. Georgia Power	59	66,000	6	176,000	7	St.	500		156
Illinois	Chicago San. District	30	44,000	9	280,000	19	Al.	350		190
Manitoba	Winnipeg City Light & Power	77	66,000	6	278,600	19	Al.	500	940	330
Mexico	Mex. Northern Power	157	110,000	6	280,000	7	Al.	575	1100	320
New York	Cedars Rapids Mfg. & Power	60	110,000	6	500,000		St.	660		450
New York	Niagara, Lockport & Ontario	180	60,000	6	500,000	19	Al.		1250	2000
New York	Northern Power Co.	60	80,000	6	105,600	7	Al.	550		94
North Carolina	Southern Power Co.	210	100,000	6	Various	Var.	Al.	550	1600	500
North Carolina	N. C. Elec. Co.	80	88,000	3	105,600	7	Al.	300		62
Ontario	Hydro-electric Comm'n.	700	110,000	6	Various	Var.	A S	550	1100	700
Ontario	Nipissing Power Co.	20	22,000	3	66,360	7	Al.			10
Ontario	Simcoe Railway & Power	25	22,000	3	105,600	7	Al.			25
Oregon	Mt. Hood Railway & Power	42	57,000	3	167,800	7	Al.	132		55
Oregon	Portland Rly. L. & P.	30	60,000	6	250,000	19	Al.	500	1800	110
Pennsylvania	Pa. Water & Power Co.	40	70,000	12	300,000	19	Al.	500	1280	360
Quebec	Shawinigan W. & P. Co.	85	100,000	6	250,000	19	Al.	600	1400	330
Washington	Wash. Water Power Co.	177	60,000	3	270,000		Al.	250	910	30
Washington	Whatcom Co. R. & L.	42	60,000	3	139,000	7	Al.	135		44
West Virginia	Appalachian Power Co.	200	88,000	3	105,600	7	Al.	250	1200	155
Washington	Puget Sound Traction	142	55,000	3	211,600	7	Al.	175	450	220

Power Supply in Ontario's Mining Districts

Description of the New Compressor Plant of the Canadian Mining and Finance Company, Timmins, Ont.

By Mr. H. E. Mueller

The increased interest taken in this district, undoubtedly caused by the remarkable success and good showings at a number of mines, has warranted, and practically demanded, an increase in capacity of mining and milling apparatus at such properties. The original apparatus has long since been laid aside as too small, and has been replaced with machinery of greater capacity, which, in turn, has been added to, or again enlarged by replacing, and so on, as the property became developed.

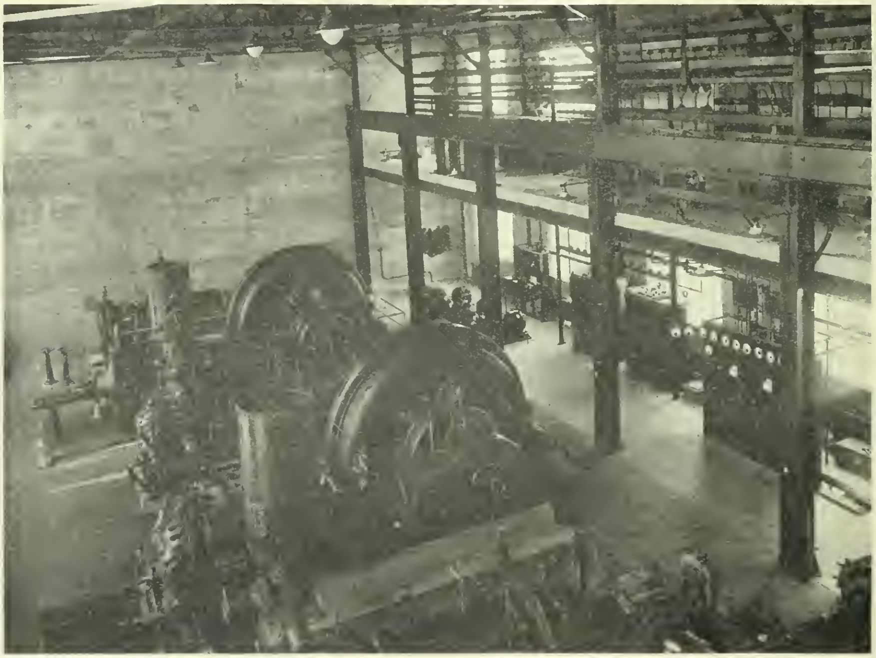
In the early part of 1911, power for driving this machinery was obtained through steam. In the fall of the same year, power was first transmitted from a hydro-electric station on the Mattagami River. Since then the steam drive has been replaced, wherever possible, with electric motors. The development of a second waterfall on the same river added to the available power, so that at the present time nearly 10,000 horsepower of electrical energy is being supplied by these plants for light and power at the mines and various towns. The hydraulic end of the above plants has lately been entirely remodelled and reconstructed and they are now in a more serviceable condition than previously.

The latest and largest step in the line of increasing of mining capacity is now nearing completion in the new power house of the Canadian Mining & Finance Company, situated on the shores of Gillies Lake, Timmins, Ontario.

Power is supplied by the previously mentioned plants at about 11,500 volts and is used at this potential by synchronous motors, direct connected to horizontal air compressors which supply air at about 100 lbs. pressure to the mines of this company (Hollinger, Acme, Miller, Middleton).

Power House

The power house, a steel frame with reinforced concrete walls and roof, is 170 feet long, 53 feet wide and, neglecting basement, 34.6 feet high. It is divided into two sections, the compressor room and the boiler house. The former, 119 feet long, contains the air compressors and electrical apparatus, and a 20-ton travelling, hand-operated crane. The latter section contains the boilers, electric and steam pumps. Both sections are liberally fitted with large steel frame windows. Ventilation is obtained through these windows, and four ventilators on the roof.



Interior of new motor-driven compressor plant—2500 h.p. capacity.

The present installation will consist of three 770 h.p. synchronous motors, direct connected to air compressors rated at 4,600 cu. ft. per minute, four 350 h.p. vertical water tube boilers and steam and electric pumps for feeding boilers and cooling compressors. Space has been allowed in the compressor room for additional compressor units for future installation.

High Tension Layout

A three-phase high tension line runs to the lightning arrester house, situated about 100 feet from the power house. The service taps from the power house meet this line at an angle of less than 45 deg. at the arrester house. This is to serve as an "inducement" for the lightning and line surges

to "get off" at the right place. Directly inside the station the line runs through a set of disconnecting switches and choke coils, thence to the main oil switch, situated on the high tension gallery located on one side of the compressor room over the control board. The running switches of the motors, auto-transformers, step-down transformers for exciting and power purposes, and potential transformers, are all tapped from a general bus fed through this main switch.

The auto-transformer switch controls a bus to which two auto-transformers are connected, the secondary sides of which are tapped to another set of buses, to which the starting taps of the motors are connected. The secondary side of one transformer is left disconnected and will be used for spare.

All the high tension self-contained oil switches, disconnecting switches, series transformers, bus bars, etc., are rigidly mounted on an angle and channel iron framework.

Electrical Apparatus

Three 770 h.p., 125 r.p.m. synchronous motors with two auto-transformers, three motor generator exciter sets, oil switches, switchboard, lightning arresters and other accessories were supplied by the Canadian Westinghouse Co.

The extra heavy type of rotor on these motors makes a separate flywheel unnecessary. Heavy low resistance rings encircling both sides of the field poles, inter-connected at each pole with copper bars slotted in the pole face, practically eliminate all "dead points" in starting and serve as dampeners during operation. Each motor is rated at 770 h.p. with a kv.a. input of 608, making the efficiency at full load and unity power factor 94.5 per cent.

Two auto-transformers rated at 1200 kw. 11000/9550/5750 volts, are situated to the left of the switchboard on the compressor floor.

The three motor generator exciter sets, mounted in individual cast iron bed plates, to the left of the auto-transformers, are each 3 phase, 550 volt, 1400 r.p.m., 22 h.p. squirrel cage induction motors, with 125 volt, 120 amp. compound wound generators with interpoles. Each set is equipped with a starting compensator with no voltage release. Motors are protected with fuses. The equalizer is brought with the positive and negative conductors to buses on the rear of the control board, through triple pole, double throw quick break knife switches.

Each motor panel is fitted with an a.c. ammeter, d.c. ammeter, power factor meter, recording wattmeter, two double pole, double throw knife switches, one of which has a field discharge resistance attachment, and three operating levers for the starting and running switches of the motors.

The upper point of the field switch is connected to the central point of the double throw master switch, whose upper and lower positions are connected through the buses to the corresponding positions on the main exciter switches on the exciter panel. The lower position of the field switch is short circuited and used in this position while starting. The running switches are each equipped with inverse time limit overload relays which are mounted directly under the circuit breakers. A graphic recording wattmeter and an a.c. ammeter, mounted on the feeder panel record and indicate the total power consumption.

On the high tension gallery are situated two banks of single phase, oil insulated, self cooled transformers, three to each bank. One bank rated at 45 kv.a. will be used exclusively for the motor generator exciter sets. The second bank, which also has a secondary voltage of 550, will be used for light and power. Two single phase, 75 kv.a., 550/110 transformers connected in open delta, step the voltage down for lighting.

Illumination

A row of eight, one thousand candle power nitrogen-filled lamps, with diffusion globes and reflectors, mounted under the roof structures, together with fourteen 100 watt tungsten lamps mounted in brackets under the crane track, are used to illuminate the compressor room. The 100 watt lamps in the brackets, aided by the powerful nitrogen-filled lamps, reflecting from above and into the centre, practically eliminate all shadows. The switchboard and high tension gallery are well illuminated with 100 and 250 watt lamps.

Below each bracket along the crane track is a plug-in receptacle for extension lamps. All conductors for light and power are run through rigid conduit.

Air Compressors

Two of the three air compressors are of the Nordbery Manufacturing Company make and are so designed and equipped that they can be used as steam engines in event of failure of power or lack of power supply. The motors will then be run as generators and will supply the third compressor and various mill motors with electrical energy. It is estimated that to change over as above described will take less than half a day. This includes firing of the boilers, which will have a forced draft.

A feature on the third compressor (Fraser & Chalmers) is an automatic pressure regulating device, which opens a relief valve on each compression stroke of the high and low pressure cylinders, when the pressure becomes excessive. On opening, this valve by-passes a quantity of air from one end of the cylinder to the other or from the compression to the suction stroke, causing a drop in its output and the amount of power consumed. This drop is generally gradual, and differs in amount according to the dropping of the air load in the compressors. When the pressure commences to lower, the relief valve cuts off the amount of by-passing air and the compressor is slowly loaded. In this way it loads and unloads itself in a gradual manner, resulting in no noticeable fluctuation in voltage or frequency on the line.

The unloading device on many compressors, on the pressure reaching a pre-determined high value completely cuts off all air to the compressors, resulting in the sudden drop of nearly all load on the motor. Then when the pressure reaches its low value the governor opens the air inlet wide and the motor is immediately fully loaded. The frequency and voltage fluctuations caused by this loading and unloading are naturally quite noticeable, particularly on small systems.

Starting Compressors

When starting a unit, valves releasing the air from the cylinders to the atmosphere are opened, thus preventing a rise of pressure and an unnecessary load on the motor. The field switch is then thrown to its lower position, short circuiting the field (rheostat having been adjusted to allow flow of about 50 amps. through the field). After energizing the auto-transformer the first step to the motor is closed and it starts up taking about 70 per cent. over rated current for a short period. The total time required between closing the first step and the running switch averages about 40 seconds.

Two units are at present in operation. The third unit is expected to be ready in late December or early January.

Rural Telephone Improvements

The British Columbia Telephone Company's system connecting up Fraser Valley with Vancouver has been improved by the stringing of high aerial wires across the Fraser River at Mission to replace the submarine cable, which was constantly being interfered with by the changing bed of the river and the snags carried down by the current when the river was in flood.

A new circuit recently completed gives Port Moody citizens direct telephone communication with Vancouver. Previously the route was by way of New Westminster.

Data on Long Transmission Lines

Some Comparisons of the Phenomena Observed on a 143 Mile Line and a 240 Mile Line—Distance Limits Being Approached

By Mr. R. A. Philip

Two long transmission lines have recently been completed by the Stone & Webster Engineering Corporation. The first, from Keokuk to St. Louis, is 143 miles long; and the second, from Big Creek to Los Angeles, is 240 miles long. A comparison of these two lines shows how increased length modifies line phenomena and that line lengths are approaching a limit where ordinary methods of operation must fail.

The Keokuk line comes within the range of customary methods, but the electrical design of the Big Creek line presents a different plan of operation which indicates the direction in which the design of the longer lines of the future may be expected to tend as the new difficulties become more pronounced.

On long transmission lines it has been noted that the voltage at the delivery end has invariably been higher than at the generating end when the line is carrying no load. Theory indicates that this is also true for short lines but that the amount of rise is inappreciable and may, therefore, be neglected. Within ordinary ranges the rise increases as the square of the length of the line, that is about 41 per cent. increase in length doubles the rise. On short lines this is unimportant, on the principle that the double of nothing is also nothing. On longer lines the change from a small but appreciable rise to a large and serious rise is rapid.

The rise of voltage in a transmission line is a special case of what occurs when a relatively small condenser is charged with alternating current through an inductance. The voltage across the terminals of the condenser rises to a higher value than the applied voltage. The percentage rise obtained depends on the relative amount of capacity and inductance. One particular relation between capacity and inductance produces the phenomenon called resonance, where the rise becomes indefinitely great.

In a transmission line the percentage rise of voltage depends almost entirely on the length of line and the frequency. The voltage used has no effect on the percentage rise, that is to say, the 110,000 volts used on the Keokuk line and the 150,000 volts on the Big Creek line do not produce greater percentages of rise than would occur were the lines charged with 110-volt current from a lamp socket. The number of volts rise is, of course, greater for the higher voltage; for 10 per cent. of 150,000 volts is 15,000 volts, while 10 per cent. of 110 volts is only 11 volts. The resistance of the wire, its size and spacing are comparatively unimportant factors and for present purposes it is sufficiently accurate to say that they make no difference.

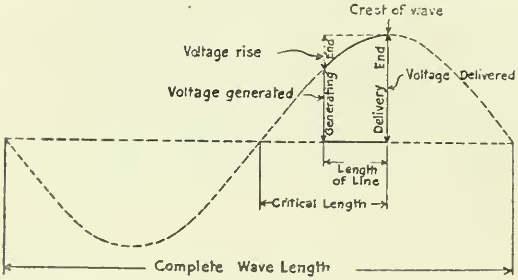


Fig. 1

As lines grow longer, the capacity reactance decreases and inductive reactance increases with consequent increase in voltage rise. One particular length of line gives the relation which produces resonance. If voltage is applied to a line of this length it will build up indefinitely, that is, until something happens. The voltage may increase until the insulators arc over or puncture or the charging current may become great enough to burn out the generator. If the source of supply is feeble, the building up may be limited by the dissipation of the available energy in line loss.

The length of line which produces resonance depends on the frequency alone, that is, for each frequency there is a critical length where resonance occurs. The critical length may be computed by means of transmission line formulae but a different method gives a short cut.

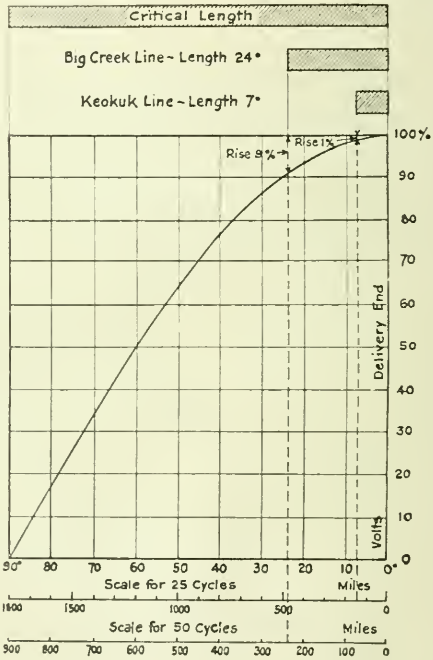


Fig. 2

Electric phenomena are transmitted with the velocity of light, that is, about 180,000 miles per second. In an alternating current of say 60 cycles per second, the "front end" of a cycle has 1/60 of a second start over the "rear end." With 1/60 second start and traveling at 180,000 miles per second, the beginning of one cycle will be 3,000 miles away when a new cycle is ready to start. This is expressed briefly by saying that a 60-cycle current has a natural wave length of 3,000 miles. The wave length for other frequencies are inversely as the frequency: 7,200 miles for 25 cycles, 3,600 miles for 50 cycles, etc.

The length of line which produces resonance is found to be one-fourth of the natural wave length; or 1,800 miles for 25 cycles, 900 miles for 50 cycles and 750 miles for 60

cycles. These lengths are then the critical lengths for these frequencies.

In a line of critical length ordinary methods of operation must fail for it is impracticable to charge the line with the receiving end open. The critical length, therefore, furnishes a measuring stick for determining whether a line is long or short. When the critical length is so far off that it may be disregarded, the line may be classified as short; while a line long enough to require those precautions which are essential in the vicinity of the critical length is a long one.

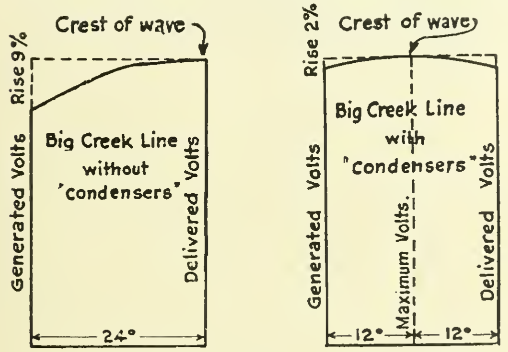


Fig. 3

On this basis, the Keokuk line is short but the Big Creek line is nearly, if not quite, long.

In comparing the electrical characteristics of lines of different frequency the relative length in miles does not furnish as good a basis as the proportion each is of its respective wave length. The wave length is an inconveniently large unit so that, like a circular arc, it may be considered divided into 360 degrees to give a convenient unit. For electrical purposes the length of transmission lines may, therefore, be better stated in degrees than in miles. At a frequency of 25 cycles each 20 miles is one degree of length, at 50 cycles each 10 miles and at 60 cycles each 8 1/3 miles is a degree.

On this basis of comparison, the length of the 25-cycle Keokuk line is about 7 degrees, and the 50-cycle Big Creek line about 24 degrees. The critical length in all cases being 90 degrees.

At no load the voltage rises along a transmission line in proportion to a sine wave, the delivery end always being at the crest of the wave (Fig. 1). This makes the relation between generated and delivered voltage very simple. Taking the delivered voltage as unity, the generated voltage is proportional to the cosine of the length of the line expressed in degrees. As the cosine of 7 degrees is .99 and of 24 degrees is .91, it follows that the generated voltage is 99 per cent. of the delivered voltage on the Keokuk line and 91 per cent. on the Big Creek line.

Fig. 2 shows a graphical basis of comparison for simple transmission lines in general of all lengths, frequencies and voltages, and shows the position occupied by the Keokuk and Big Creek lines respectively in comparison with the critical length.

Even on the Big Creek line the ratio of delivered to generated voltage is not so great as to require any extraordinary precautions. The diagram shows that for longer lines the delivered voltage will increase to double and triple the generated voltage and at the critical length the ratio is as one to zero, that is, infinitely great.

The Big Creek line, therefore, differs from the Keokuk line, not in requiring new methods because of the rise in voltage, but in providing methods, though for other reasons, which would make the operation of a line of critical length possible.

The Big Creek line is a new departure in providing, at the delivery end of the line, synchronous condensers which are considered an integral part of the line design. In fact, the generators and condensers each with their voltage regulators are considered with the line as one unit of design. While the principal function of the synchronous condensers is to furnish leading current, thereby raising the voltage at the delivery end when the line is loaded, they have an almost equally important secondary function of furnishing lagging current for reducing the delivered voltage at no load. By raising the voltage at full load and lowering it at no load, the condenser makes it possible to maintain a constant voltage of 150,000 at each end of the line over the whole range of load. For present purposes it is sufficient to consider the effect of this plan at no load only.

With no load on the line (but with the synchronous condensers running because they are to be considered as a part of the line itself and not an external load) half of the charging current of the line will come from the condensers and half from the generators. Under these conditions the crest of the sine wave of voltage is no longer at the delivery end of the line but is moved to the middle of the line as shown in Fig. 3. This change is equivalent to substituting two separate lines each of 12 degrees of length for one 24 degrees long. The maximum voltage now occurs at the middle of the line and as the cosine of 12 degrees is about .98 the generated and delivered voltage will be about 98 per cent. on the maximum. That is, the rise of voltage has been cut down from about 10 per cent. to 2 per cent. of the generated voltage.

As before stated, the length of the Big Creek line is not sufficient to make control of voltage rise necessary, but the radical nature of the step taken in providing such control is apparent in the case of a line of the critical length. Under ordinary operating methods the rise on such a line figures as infinite and its operation impossible. With a condenser at the delivery end as part of the line, the length of the line is virtually reduced from 90 degrees to 45 degrees. As the

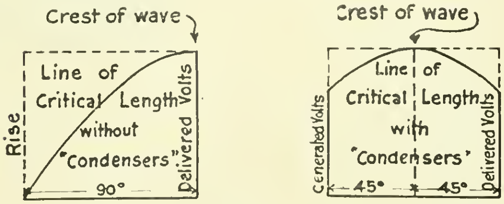


Fig. 4

cosine of 45 degrees is .71 the voltage at the ends of the line will be 71 per cent. of that in the middle, or the rise will be about 41 per cent. of the terminal voltage; a large but not impossible amount. Without condensers the delivered voltage would be infinitely greater than the generated voltage, while with the condensers the voltage at the two terminals would be equal as shown in Fig. 4.

The Big Creek plan, therefore, makes possible the operation of lines of the critical length.

The controlling of voltage rise is but one of the useful functions of the condensers. In so far as they are used for this purpose, they are not so very different from reactance coils and if this were their only function they might with advantage be replaced by such coils. That is, reactance coils connected in multiple with the transmission line at the delivery end or at intermediate points would properly hold down the voltage at no load, but would fail to raise the voltage at full load as is desirable.

Such reactive coils on a transmission line would be close-

ly analogous to the "loading coils" used on telephone lines, the purpose being substantially the same; that is, to neutralize the effect of the distributed electrostatic capacity of the line by adding a partially distributed inductance.

On telephone lines the problem was met much earlier than on transmission lines because of the higher frequencies used and the greater lengths of line operated. Taking 500 cycles per second as an ordinary telephone frequency, the wave length is but 360 miles and telephone lines over 2,000 miles long are in use. Thus telephone lines have already covered several complete wave lengths while transmission lines have not yet attained a length of one-quarter of one wave.

It appears that the long transmission line, like the long telephone line, will differ from the short line in being "loaded." The problems of "loading" transmission and telephone lines are not quite identical so that somewhat different solutions may be expected. The Big Creek line is probably the first systematically "loaded" power line and indicates that power line "loading" practice will diverge from telephone practice from the beginning. Telephone lines are "loaded" with coils of fixed inductance while power lines will probably be "loaded" with synchronous machines which will act as inductances at no load and as condensers at full load.

The Big Creek line is "loaded" at its terminals only and that is sufficient as the line covers only about one-seventh of a wave length. On longer lines intermediate "loading" may be desirable. For example, the quarter wave length line has a rise of 41 per cent. at the middle when "loaded" at the terminals. An additional "loading" at the middle would reduce this to about 8 per cent.

On still longer lines resonance may occur even with terminal "loading" so that intermediate "loading" will then be essential. Thus a line covering half a wave length may act as two lines of a quarter wave length if "loaded" at the terminals only. The voltage at the middle point would then build up indefinitely unless restrained by intermediate "loading."

Interior Districts Will No Longer Be Isolated

That the Dominion Government is earnestly pursuing its policy of linking up the isolated districts of the interior of British Columbia with the centres of population is shown by the fact that east of Ashcroft over 400 miles of new telephone lines, being constructed in Kamloops, Okanagan, Kootenay and boundary districts will give a total of 1,200 miles of government lines. The line from Golden to Windermere has been entirely rebuilt, the work comprising a new metallic circuit and up-to-date exchange at Golden, and local exchanges at Windermere, Athalmer, Invermere and Wilmer. Lines are also being built from Midway to Osoyoos, and from Fairview—the end of the present government line—to Oroville, which will give direct connection from the Cariboo lines through the Okanagan district to Oroville. From Nelson a line will extend to Trail and Waneta via Columbia Gardens. A central call office at Nelson will be connected with the local and long distance lines of the British Columbia Telephone Company.

Two Marconi wireless stations have been installed at the campus of McGill University, the apparatus having been loaned to the University by the Militia Department, supplemented by telephones, etc., by the Northern Electric Company. Twenty-nine students, mostly fourth year, taking the electrical classes, are receiving instruction in wireless telegraphy under Professors Gray and King and Mr. E. G. Burr. The students have all enlisted, this being a condition laid down by the Militia Department prior to loaning the apparatus. The men will thus be ready for active service if called upon.

Personal

Mr. C. A. Howe, formerly manager of the Holophane Company of Canada, has been appointed general sales manager for the George Cutter Company.

Mr. James Hyde, former superintendent of the Dorchester Electric Company, has rejoined the staff of the Montreal Light, Heat and Power Company.

Mr. Frederic Nicholls, president and general manager of the Canadian General Electric Company, has been appointed an honorary colonel of the Canadian militia.

Mr. A. Gaboury, Superintendent Montreal Tramways Company lectured recently before the Montreal Electrical Association on the subject of "Safety First." The Montreal Tramways Company have been active supporters of this movement.

Mr. T. J. Kennedy, president and general manager of the Algoma Central & Hudson Bay Railway and the Algoma Eastern Railway, Sault Ste. Marie, Ont., has also been elected vice-president and general manager of the International Transit Company and the Trans St. Marys Traction Company, in charge of street railways and ferries.

Mr. F. D. Nims, chief engineer of the Western Canada Power Company, Limited, has left that company to take up a similar position with the Olympic Power Company, Port Angeles, Wash. Prior to his departure Mr. Nims was the recipient of numerous testimonials, indicative of the prominent part he has taken in B. C. electric circles. Mr. Nims is a fellow of the American Institute of Electrical Engineers and has been very active in the operation of the Vancouver section of the institute.

Obituary

Mr. F. C. Robertson, Inspector of the Ontario Division of the C. P. R. Telegraph System, died recently at his home in Port Hope.

Following a brief illness, Mr. Jas. A. Baylis, chief engineer of the Bell Telephone Company of Canada, died recently at his home in Montreal. Mr. Baylis was born in Montreal in 1869 and gained his primary education in that city. He later attended the Worcester Polytechnic Institute, where he obtained his engineering degree. In 1890 he joined the staff of the Bell Telephone Company, and for the past 24 years, has held the position of chief engineer.

New Books

School of Practical Electricity—Published by the Electroforce Publishing Company, Milwaukee; price, $4.50. This book is divided into a number of sections, each section written by an authority in that particular line of electricity. The authors are Oscar Warwath, E.E., George K. Kirchgasser, Frederick G. Raeth, W. P. Hennig and R. A. W. Tanns. The sections are:—principles of electricity, batteries and low potential electric wiring; theory of direct-current; electric light wiring with problems; magnetism and the commercial application of magnets; and telephony. The book is so written as to be readily understood by the student, electrician, engineer or architect. Numerous diagrams and illustrations are used throughout. Each section of the book is complete in itself, as is indicated by the section on electric light wiring, which has chapters devoted to the following:—electric circuits; insulation and capacity of conductors; interior wiring system, how installed; Underwriters' restrictions covering all wiring installations; wiring in special locations; fittings and accessories; switches and their connection for control from different locations, three-ways, etc. Practical problems in everyday wiring, wire splicing, etc. Sign lighting; complete wiring of a residence; and electric illumination.

Electric Railways

The Development of the Motor Bus—Of Proven Worth in Serving Outlying City Districts—Cheaper Both to Instal and Operate

At many points in the United States the use of motor buses is proving to be a very satisfactory solution of the transportation problem in the outlying districts, where traffic does not yet warrant the standard railway extension. As an example, the Cleveland Railway Company, Cleveland, Ohio, recently purchased three twenty-six passenger motor omnibuses, mounted on three-ton White chassis, from the G. C. Kuhlman Car Company.

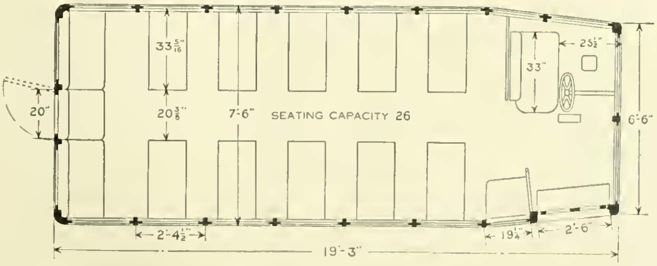
One man prepayment motor bus, typical of a number giving satisfactory service in Cleveland and other U. S. cities. Entrance and exit by same door. Seating capacity twenty-six.

It is the intention of the railway company to operate these buses as feeders to the railway system in outlying districts and in suburbs which have not developed to the extent which warrants railway extension. It is expected that this enlargement of transportation facilities will stimulate the growth and development of the suburbs to the advantage of both the city and the railway system.

The buses illustrated are designed for one-man prepayment operation, the entrance and exit of passengers at the forward right-hand corner of the body permitting the driver to collect the fares and control the operation of the simultaneously-acting folding doors and lower step from his position on the left side. All sashes are of the double type, the upper half being stationary and the lower arranged to raise. Directly in front of the driver's position, on the left side of the body, the sash is equipped with a glass shield, which prevents rain or snow interfering with his vision in stormy weather. Brill "Winner" seats, with stationary backs and upholstered in twill-woven rattan, arranged as shown on the diagram of the seating plan below, provide a maximum seating capacity of 26 for this size body. A section of the rear cross seat, directly in front of the emergency door, which may be operated by the passengers, is removable. The driver's seat, upholstered in leather, is located directly over the gasoline tank. The heating system is connected to the exhaust from the engine, and is equipped with valves with which the exhaust may be transferred to the muffler in warm weather. Ventilation is obtained through two ventilators located on the top panel on each side of bus.

In the underframe, the construction may be called composite; the side sills, 2¼ by 4 5/16 in., rear-end sills 2¾ by 5⅝ in., and cross member fillers 1⅜ by 1 13/16 in., are of oak, while the crossings consist of seven 3-in. 4-lb. channels with oak fillers, mentioned above, to which the flooring is laid. Ash is the material used in the upper framing, the corner posts being 3½ in. thick, and the side posts 1⅜ in. thick. The exterior sheathing is poplar. The three-ton White chassis on which these buses are mounted is of a special design, and is equipped with the Westinghouse air spring shock absorbers both at the front and rear.

Plan of Cleveland omnibus—These cars are proving their worth in well settled sections where street car service is poor, as auxiliaries to the regular lines.



Tramway Labor Conditions in Europe

Wages Lower, Rates Higher and Transportation Facilities Inferior to our Own—Report on a Number of Continental Cities

At the annual convention of the American Federation of Labor in Philadelphia last week there was a special report entitled "Labor Conditions on European Municipally Owned Railroads," presented by W. D. Mahon and L. D. Bland, who visited Europe this last summer in accordance with the following resolution adopted last year at the Seattle convention of the federation.

"Whereas, the question of municipal ownership and operation of street and electric railways is being considered by a number of the municipalities throughout the United States; and

"Whereas, this is an important question to the thousands of organized workers in the various trades and callings that follow this line of employment; therefore, be it

"Resolved, That the president and executive council of this American Federation of Labor are hereby instructed to make a thorough investigation as to the wages and hours of labor and the conditions of employment, including the rights of the employees to collective bargaining and the protecting of their labor through organization in such countries as have already adopted and are now operating their street and electric railways under municipal ownership, the results of this investigation to be submitted to the next convention of this federation with recommendation thereon."

An abstract of the report as given in the Electric Railway Journal is printed below:

Germany

Of the 209 tramway systems in Germany, 134 are in the hands of private companies while the other seventy-five are owned and operated by local administrative bodies, districts or municipal councils. In some cases there is joint ownership by the municipalities and private parties, and there is a tendency to place the operation of these jointly owned properties in the hands of private parties to avoid the responsibility of operation and of dealing with the labor question.

Organizing the street railway workers of Germany has proceeded with great difficulty and under trying circumstances. It is claimed by some that the tramway employees have no legal right to organization. Old age, sickness and accident insurance are compulsory by law. According to Mr. Rathmann, the tramway representative of the Transportation Workers in Berlin, "A sudden rush to join the organization as soon as it is worth while, that is, to secure an increase in wage, and quite as sudden a rush to leave it as soon as the movement is over, seems to be a peculiarity of the tramway men, which in spite of all educative efforts of our union we have not been able to exterminate up to the present."

The report adds that although the German union, during the past three years, has fought on behalf of no less than 36,631 employees for an increase of wages, the records for 1912 show that among all these numbers there were but 8,528 in good standing in the organization. The strikes of German tramway employees have been of short duration, the longest on record being three weeks. This occurred in Konigsberg in 1912.

Under the head of "working conditions" the report says that the organized workers of Germany have no general labor contracts as in the United States. All contracts are made by the individual worker with his employer. He makes a contract to cover his probation period, then after he is accepted as a regular man, he makes another contract. Except as the organization has been successful in modifying them, the contracts are severe in their demands, restrictions and penalties.

The following are some of the working conditions of German tramway employees, according to the report, except that the money is translated into American currency:

"A man going to work on the trams must practice for eight weeks to learn the business. This is a government regulation. For that work he gets 60 cents a week. He must also put up an indemnity in the way of a forfeiture, averaging about $18, and this stands against him, indemnifying the company in cases of breakage or any violation of the company's rules and regulations, for all concerns have a system of fines ranging anywhere from 24 cents to as high as $3.60 or $3.84, which are imposed for the violation of rules and regulations. So if a man should fail to report in the morning and lose his run he would be fined from 24 cents to 48 cents for such offence.

"The medical test in the tramway service throughout Germany is very rigid. In addition to answering satisfactory specific questions pertaining to military service, an applicant must undergo a thorough examination by the officiating doctor and be pronounced physically sound.

"The company reserves the right to discharge without notice, while the employee who desires to quit is required to give notice in some instances as long as three months in advance. Failure to comply with this regulation invariably results in forfeiture of bond, and, as one of our German brothers put it, 'every strike is a breach of contract and if the men lose they forfeit their bond money.'

"An example of this is shown in the report on the strike of the tramway men of Saarbrucken, which occurred in 1911. It was conducted by a union not affiliated with the regular movement. The strike failed, and every striker reinstated had to pay the company 50 marks ($12) from his deposit money. The security was then increased 50 marks, so that each had to put up another 50 marks to make the deposit 100 marks ($24). The men who refused to return to work were fined by the company 92.50 marks, which practically confiscated the amount they had on deposit.

"All concerns furnish uniforms for the men, but these uniforms are furnished just as a shovel or any other tool is furnished. They are not the property of the men at all. They are simply worn while in the service, are kept in repair, and when the men leave the service they must be turned back to the company, or else they must be paid for out of the indemnity which the employee deposits on entering the service."

The report, in comparing the wages in 192 German cities, on both municipally and privately owned systems, says that the average wage for motormen during the first ten years of service varies from 73.5 marks ($17.64) to 147 marks ($35.28) per month. During the first five years of employment there are fifty-six concerns that pay from 73 to 90 marks ($17.25 to $21.00) and 124 that pay from 90 to 105 marks ($21.60 to $25.20). Some of the wage scales call for fifteen, twenty and thirty years of service and even more before the maximum pay is reached. The conductors usually get about $3 a month less than the motormen. This difference they are supposed to make up in tips they receive from the riding public.

France

There is no municipal tramway department in France. In Paris there are some 24,000 men employed in the tram-

way, underground and omnibus systems; 10,000 on the trams or surface railways, 5,000 on the underground, and 9,000 on the omnibus service. Of these the tramway and underground men have responded least to organization.

The systems of wage on the transportation lines of Paris differ. Some employees are paid by the month, some by the day, and others by the hour. In the train service there are five grades of pay. In the fifth class men receive 165 francs ($33) a month; fourth class, 175 francs ($35) a month; third class, 185 francs ($37) a month; second class, 195 francs ($39) a month, and first class, 200 francs ($40) a month. The entrance to these various classes is not fixed by time service, but depends upon vacancies in each, so that promotion from a lower to a higher class, with resultant increased pay, can come only when a vacancy occurs. The workday on the Paris trams is ten hours, and most of the runs are completed within twelve hours. The law provides one day off in seven.

Switzerland

There are forty-one tramway systems in Switzerland, eight of which are operated by municipalities and thirty-three by private concerns. The total number of all tram employees in Switzerland is 3,553, including all classes. The right of the workers to organize is guaranteed by law. The laws of Switzerland also provide for insurance against sickness and accident. The managements are compelled to insure all employees and pay all premiums.

The wage at Berne for conductors starts at 150 francs a month, or $30, and reaches 220 francs a month, or $44, in ten years. The beginning wage for motor men is 155 francs a month, or $31, and after ten years the maximum is 230 francs, or $46 a month. The workday is nine to ten hours, completed in fourteen to fifteen hours. Berne has a municipal line. On the privately operated trams in Switzerland, the wage paid employees is a trifle less than on the municipal roads.

Italy

The investigation of the conditions in Italy was interrupted by the outbreak of the war. Some figures, however, were obtained in Rome and Milan. In Rome there are one steam and four electric lines. One of these is owned by the municipality, which will take them all over in 1920. The wages on the private lines begin at 64 cents a day, and the maximum wage after ten years' service is 94 cents a day. The workday is nine hours, completed in about thirteen hours.

The wage on the municipal road is 10 cents a day more than on the privately owned roads, but other conditions are about the same. On the municipal system the employees are paid every two weeks, and on the private systems they are paid every week. Trainmen on all roads have one free day in every fifteen.

Great Britain

Two cities only in Great Britain were investigated, London and Glasgow. The wages for the motormen and conductors on the lines of the London County Council Tramways are from $1.20 to $1.60 day. These wages are higher than on the privately owned lines in or about London, but the latter are all outside the County area and in less congested districts. The workday is nine to ten hours, completed in fifteen, and the six-day week prevails.

In Glasgow the employees in the various mechanical departments of the municipal tramways to the number of about 400 are organized, but the motormen and conductors, who number 3,012, have no union. One was organized in 1911, but disbanded after a strike. The men work a six-day week of fifty-one hours. The wages per week for motormen and conductors vary from $6.48 for the first year to $8.16 for the seventh year and $8.40 thereafter. The physical tests required are very rigid and more exacting than for military service.

Conclusions

The conclusions in full follow:

"We began our investigation of conditions surrounding the tramway workers of Europe with an open mind. We were ready for impressions and determined to report facts as we found them. The war prevented us from going into the investigation as thoroughly as we had planned, yet the field that we covered and the access we had to information gave us a good understanding of conditions.

"The tram systems of Europe are not to be compared to the street railway systems of the United States. Throughout continental Europe and the United Kingdom, in the most thickly populated centres, the street railway service is inferior to ours in many respects. In the continental cities the track mileage is small compared with the United States. This contributes to density of traffic and profitable operation. The same is true of the United Kingdom, whose total street railway trackage is about 3,600 miles as against 40,470 miles operated in the United States

"We found the same spirit of commercialism dominating the electric railway systems of Europe, private and municipal, as exists in this country. If any credit is to be given either, it belongs, in our opinion, on this side of the water, for the American system, to our minds, is not only cheaper to the public, all things considered, but the service is better with a great deal more of it. Cheap fares on the zone system prove dear fares to the worker if he has to ride any considerable distance or take intersecting lines, for each zone entered means an additional fare, and there are no transfers on European systems. Zone fares and inadequate wages force the workers of Europe to live close to the workshop, mill or factory. It is rare to find a European worker who can afford to live in suburb or country, miles away from his work, as is frequently the case here. The rate of fare for long distance makes it prohibitive, and the wage will not warrant the expenditure.

"Thus the zone fare system contributes to congestion and compels the workers to live in the most uninviting districts. It retards suburban development and adds to the rents of the workers, who not only have to suffer the inconvenience of small living quarters but are denied sunlight and sanitary surroundings as well.

"And right here we desire to comment that with all the claim for legislative enactments helpful to the workers, municipal utility enterprise and co-operative development, we found the living standards of the workers of Europe, tram as well as others, so far below the average of the workers of America that no comparison is possible. The rapidity with which the workers of Europe are grasping the truth that their efforts must be concentrated in the economic field, through their trade unions, was the most hopeful sign that this condition would be altered.

"None of the European systems has a night car service, such as we have in our big cities. Nor have they an interurban electric service, that has contributed so much to the development of our rural districts and brought the consumer and producer into close relationship.

"Nor can there be any comparison between the wage of the European tram employee and his brother in the United States. From the viewpoint of the purchasing power of a dollar it has been estimated by careful observers that the cost of living in various parts of the United States is 25 per cent. to 65 per cent. higher than it is in various parts of western Europe. The difference in the money wage of the street railway men of these countries is much greater. The highest wage paid any body of tramway workers in Europe is safely 100 per cent. less than the rate paid in this country in the same occupation, and we found this to be the fact both on private and municipal systems.

"Our investigation showed that wherever the tram workers of Europe enjoyed advanced wage and labor conditions

their trade unions were responsible for them. Where the trade unions are active there the best results obtain, and whether dealing with a municipality or a private company the employees have found it necessary to maintain their unions to establish and protect their conditions."

Encourage Your Men

Encourage your men by expressing appreciation of the motormen and conductors who are habitually neat in their appearance and clean. The man who keeps his uniform properly mended, clean and pressed, all his buttons on, wears a clean shirt and collar, keeps his boots polished, and gives himself a daily shave, is not only a better representative of the company, but he feels better himself, does his work better, has more self-respect and demands more respect from all he comes in contact with. The effort needed is considerable, but may be formed into a habit. The extra expense of keeping one's uniform in good order is more than offset by the longer wear these uniforms will give. Encourage your men to be self-respecting. Employees who think well of themselves will think well of the company that employs them and this will go a long way towards regulating what the general public thinks.

B. C. E. R. Social Club's "Annual"

The annual office staff banquet of the British Columbia Electric Railway given by the Social Club, was held this year at the Elysium Hotel, about 125 members being present. All the chief officials were in attendance, and most of them were heard from during the evening. Following the toast to the King the toast to Canada was proposed by Mr. G. Porter, assistant chief engineer, and was replied to by Mr. R. E. Glover, general executive assistant. The toast to the B. C. Electric Railway Company followed. Mr. A. E. Beck, claims agent, and Mr. G. R. G. Conway being the speakers. The toast to the Social Club was proposed in a very happy vein by Mr. George Kidd, general manager of the company, who in closing said he was greatly impressed by the really fine type of men who composed the office staff, and was pleased to be afforded an opportunity for mingling with them through the medium of the Social Club. In replying, the chairman, Mr. W. G. Murrin, general superintendent, outlined the good work of the Club in providing facilities for social enjoyment, amusement and education. It had been established two years ago through the generosity of the company, and now numbered 175 members, who during the winter would enjoy a program of lectures, dances, smokers, tournaments, social gatherings, etc. The closing toast to "Our men at the Front," was proposed in eloquent style by Mr. Frank Harris, publicity agent, the response being three cheers and a "tiger" for the members who had volunteered at their country's call. During the evening vocal selections were contributed by the following members of the office staff: Messrs. J. R. Pacey, G. E. Watts, J. Jenkinson, R. Gray and M. F. Werth.

Toronto By-laws

By-laws will be submitted in Toronto on January 4th, authorizing the expenditure of some $600,000 in electric railway extensions. These consist of (1) construction of a civic car line on Lansdowne Avenue south from St. Clair; (2) a line to serve North Toronto passing through Mount Pleasant Cemetery; (3) the purchase of the tracks of the Toronto and York Radial Railway Company in the east, on which the franchise has expired; (4) to purchase motor-buses to the extent of $100,000 to establish a service at certain needy points in the city.

Constructing Power Plant

The Edmonton, Dunvegan and British Columbia Railway have under construction at the present time a power house to be equipped with some 250 kw. capacity in electric generators. This power house will be located at their terminal north of the G. T. P. railway track, Edmonton. The boiler equipment consists of two return tubular horizontal units, 150 h.p. each, working at 125 pounds pressure. Two generators of 125 kw. capacity each, direct connected, are expected to be in operation by the first of February, 1915. The output of the plant will be used to light their own terminal and also to operate the machinery in their car repair shop, which is also under construction at this point.

Regina Municipal

The operation returns of the Regina Municipal Railway for the week ending November 21st, 1914, were as follows:—revenue, $3,494.65; passengers carried, 81,243. For the week ending November 28th, the corresponding figures were $3,087.35 and 75,464.

Forest Hill Radial

Work has been started on the road-bed at Bathurst Street for the proposed Forest Hill Radial Railway. It is stated that the initial stage of the work on Eglington Avenue from Bathurst to Dufferin Street will be proceeded with as expeditiously as possible.

Pay Regular Dividend

The Guelph Radial Railway Company, owned by the city of Guelph, recently declared the regular 5 per cent. dividend and in addition were able to pay all expenses and set some $6,000 aside to credit of capital account.

Toronto Municipal

The Council has passed a by-law authorizing the erection of a temporary car barn in connection with the line at present under construction on Bloor Street West.

A deputation recently waited on the Board of Control, asking that plans be considered for laying car lines south of St. Clair Avenue on both Lansdowne and Bathurst Streets.

Work is proceeding satisfactorily with the civic car line on Bloor Street west of Dundas. Commissioner Harris was recently given authority to purchase rolling stock, also land for car barn purposes, and to get the car barn under way at the earliest possible date.

Tramway Situation in Montreal

Before the Montreal Board of Trade, Mr. Peter Witt, street railway commissioner for Cleveland, recently discussed the tramway situation as it exists in Montreal.

Trade Inquiries

Name and address of inquirers may be obtained on application to the Electrical News, Toronto.

1197. **Railway ties.**—An Irish firm invites from Canadian manufacturers quotations, delivered Belfast, for 25,000 to 30,000 railway ties, made up of 9 ft. x 10-in. x 5-in., and also 6 ft. x 9-in. x 4½-in.

1166. **Dynamos, electric motors, electric supplies.**—Commission agent desires buying and selling agency in Argentine Republic for dynamos, electric motors and electric supplies of Canadian manufactures.

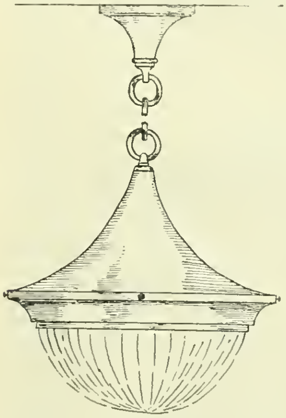
Illumination

The Illumination of Churches

Good Lighting Contributes Largely to the Enjoyment and Impressive Effect of the Service

The possibilities of correct illumination are splendidly exemplified in the photograph which we reproduce on the following page, of St. Simon's Church, Toronto. The illumination on the reading plane is practically uniform at every point and in every corner of the building. This photograph was taken at night, by the light of the regular illumination of the church. No flashlight or auxiliary illumination of any kind whatever was used. It is difficult to realize that so good an effect was possible, especially when the red brick walls are taken into consideration, these walls of course extending the full height of the side of the building.

No very special features are to be noted in connection with the wiring of this church. Below the ground floor all work is in conduit, and above the ground floor everything is in armored cable. The switches and cutouts are installed in separate compartments of the same cabinet, each compartment having its own door and lock. The switches used are standard 10 ampere, Diamond H, indicating, rotary type; no knife switches are used. The cabinets are set flush with the panel work and finished to match. The meters in the basement are equipped with the Metropolitan Engineering Company's devices, which are being installed on all the larger services in Toronto, by the Toronto Electric Light Company, and the Hydro-electric System.



Design of unit used in St. Simon's Church, Toronto.

The proper illumination of this church, and especially the chancel part of it, was a fairly difficult matter. As will be noted in the photograph, the treatment of the choir section and sanctuary was chiefly with a view to bringing out the details and color effects of the decorations. St. Simon's has been recently re-decorated and is now one of the most beautiful and impressive places of worship in the city.

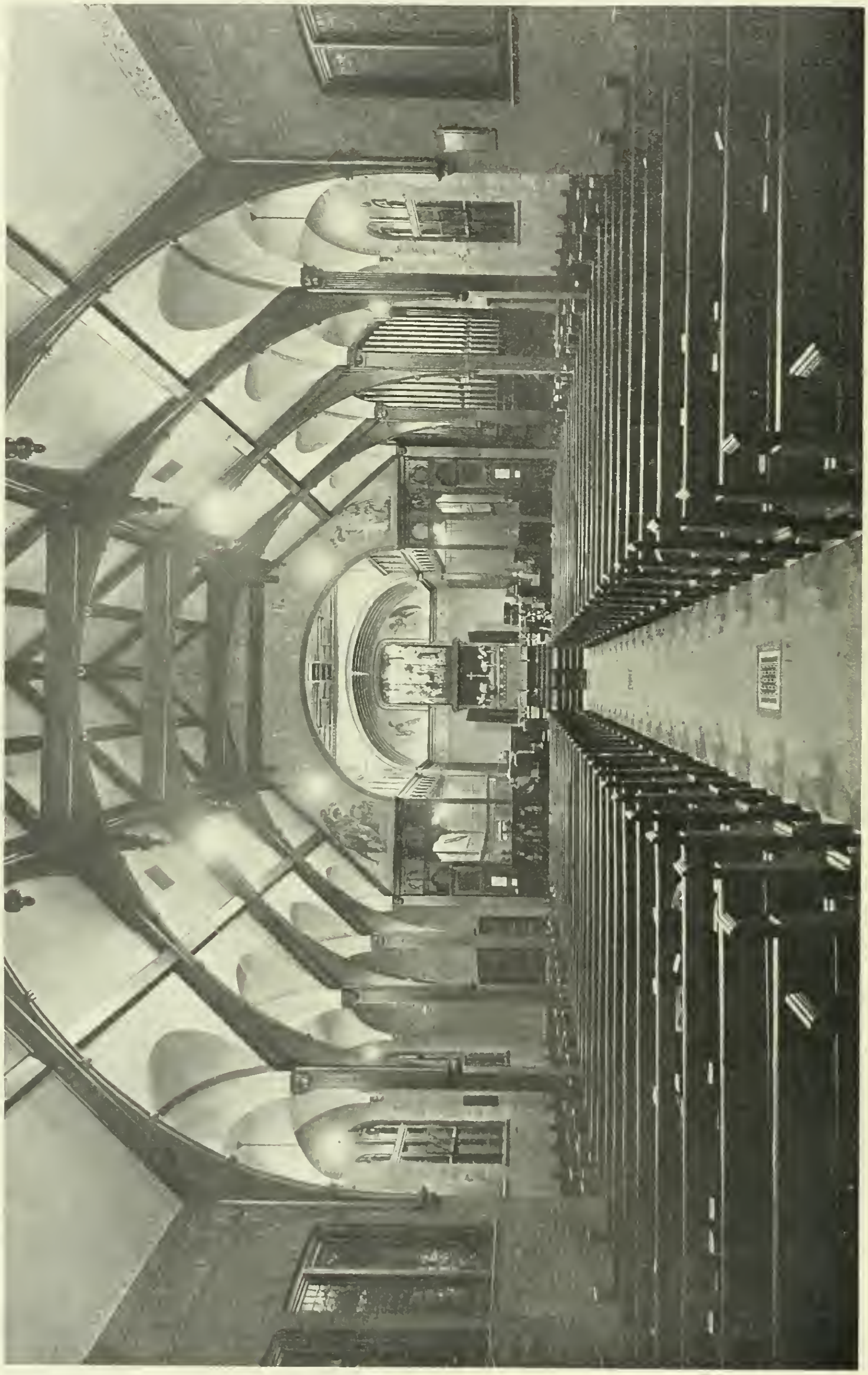
In the sanctuary, where, as shown in the photograph, there is an arched ceiling, handsomely decorated, cove lighting was resorted to. The treatment gives ample illumination for this part of the chancel and at the same time brings out very distinctly the soft, artistic blending of colors on both the walls and the ceiling. Sunbeam tubular lamps equipped with Canadian General Electric special reflectors were found best suited to give the desired results.

The choir part of the chancel is separated at the ceiling from the nave of the church by a heavy arch, which made the illumination of the decorations of the choir ceiling and walls very difficult. After much experimentation excellent results were obtained by the installation of eight 100-watt tungsten units (four on each side) enclosed in X-ray silver-lined reflectors. These are placed well up in the corner and are only visible from the chancel. The general illumination of this part of the church as seen in the photograph shows how well these units are doing their work.

Another specially interesting part of this excellent installation is the illumination of the plate glass window. Two 750-watt tungstens, enclosed in one of the new types of reflector manufactured by the Benjamin Electric Company, cause the different figures to stand out prominently and reproduce the colors in a very accurate and striking way. By this installation one of the chief beauties of the decoration of this church and which, under ordinary circumstances, appears to good advantage only in brightest daylight, has now also become a most attractive feature of the evening service. The effect of this window at night is now equally as beautiful and impressive as in bright sunlight.

The illumination of the main body of the church was rendered more difficult on account of its great height, as well as of the dark finish of the beams and ceiling. The type of unit finally chosen is that illustrated herewith, which consists of an enclosed semi-indirect semi-decorative type, suspended from the newels which project beneath the ceiling arches. In a total length of 85 feet, there are two rows of four of these units, each containing a 250-watt tungsten. In the transepts, which extend 12 ft. 3 inches to the right and left, and are 47 feet 6 inches long, eight units of the same design are installed, four on each side, each containing a 150-watt lamp. In the choir alcoves, which recede to a distance of 5 feet 6 inches to the right and left of the chancel, two units on each side containing 100-watt lamps are used The total width of the church is 61 feet, and the illumination on the reading plane with the lamps approximately 22 feet from the floor is in the neighborhood of 2.5 foot candles.

The lighting units for this installation were supplied by the Colonial Fixtures, Limited, 424 Adelaide Street West, Toronto. The installation throughout was made by Mr. Thos. Jackson, electrical contractor, 11 Sorauren Avenue, Toronto. Congratulations are certainly due the electrical contractor for the splendid results obtained under general conditions which were none too favorable, and in spite of certain special conditions which were absolutely novel and well-nigh impossible to overcome.



Example of almost ideal results in church lighting—Photograph taken at night without any auxiliary lights whatever.

Good Street Lighting in Outremont, P.Q.

First Canadian Municipality to Have all Lights Served by Underground—500, 6.6 Amp. Nitrogen Lamps on 20 Miles of Street—Specially Designed Fixtures

On December 1 the town of Outremont, P.Q., inaugurated a new street lighting system—being the first city or town in Canada to have all its street lighting system served by underground cables, and also the first city or town to adopt nitrogen-filled tungsten incandescent lamps. Madame Beaubien, wife of the Mayor, pressed the button which put the system into operation. The power is supplied by the Montreal Light, Heat & Power Company, in bulk, at the border of the town on St. Viateur Avenue over duplicate feeder circuits. From this point the power is transmitted to a centrally located town substation, adjacent to the Fire and Police Stations, by duplicate underground cables, installed by the town in the municipal conduits. At the sub-station is located the meter equipment and the constant current regulators with switchboards, which transform the power received, for the supply of 6.6 ampere constant current street lighting circuits throughout the town.

The town is at present wired for ten separate circuits supplied from five regulators, and one extra regulator installed is held as a spare for emergency use. The two lighting circuits supplied by each regulator are in every case arranged to serve widely separate districts in the town so that damage to a regulator would affect two small areas at different parts of the town and not plunge a large area into darkness.

All circuits to the lamps are carried underground; approximately four miles of cable are installed in the municipal conduit for this purpose, and the remainder is steel tape armored cable laid directly in the ground. 14,000 feet is of twin conductor No. 8 B & S steel tape armored cable, and 90,000 feet of single conductor No. 8 B & S steel tape armored cable. The cable runs out on one street and returns on another. The total number of lamps now installed is 498 and approximately twenty miles of street is illuminated.

Lamp directly over centre of sidewalk when laid.

Provision has been made for extension to this system and all plans are prepared for the addition of four more circuits. The complete system anticipates the installation of 400 more lamps, bringing the total to nearly 900. This extension can be economically made when conditions justify the expenditure. The lamps at present used are of two sizes, a 400-candle power lamp on the streets where there are tramway routes and a 250 candle power lamp on all other streets.

Combination trolley and lamp post.

The lamp posts are bracket posts, artistically designed specially for this installation and are placed on the boulevard side of the sidewalks so as to reduce all obstruction on the sidewalks. This places the lamp over the centre of the sidewalk. On tramway routes a combination pole is used to allow of the attachment of the tramway trolley span wires. The lamp standards are spaced 200 feet apart on one side of the street, but where there are tramway routes the spacing is 200 feet on both sides of the street.

All cables, lamp posts, lamps, regulators and switchboards are of Canadian manufacture, the total cost of the installation, including the sub-station building, being about $75,000. The installation was made under the direct supervision of the town engineer, Mr. Duchastel. The consulting engineer was L. A. Herdt, D.Sc., of Montreal, assisted by Mr. E. G. Burr.

The standards were supplied by the William Hamilton Company, Peterborough, Ont.; glassware by A. H. Winter Joyner, Toronto; lead covered and armoured cable by the Eugene F. Phillips Electrical Works, Limited, Montreal; 6,600 volt rubber covered cable for the standards, and the nitrogen filled incandescent lamps by the Northern Elec-Company, Montreal; 6-panel switchboards for regulators and two main panel boards for two underground incoming lines, by the Canadian General Electric Company, Toronto. Mr. G. M. Gest, Montreal, had the contract for laying the conduits.

Residents at Creston and other Kootenay points now enjoy telephone communication with Spokane, Wash., and intermediate points, the Creston line having recently been connected up with the Pacific States Telephone Company at Porthill, on the boundary.

The Dealer and Contractor

Your Christmas Window Display

Attractive Window Spells Prosperity—A Salesman That Works for You Day and Night—Suggestions for Decorations

During twelve months in the year, the show window is the best sales producer that is to be had. In December it should be at its very best for it is during the Christmas shopping season, even more than ever, that people look to show window displays for suggestions.

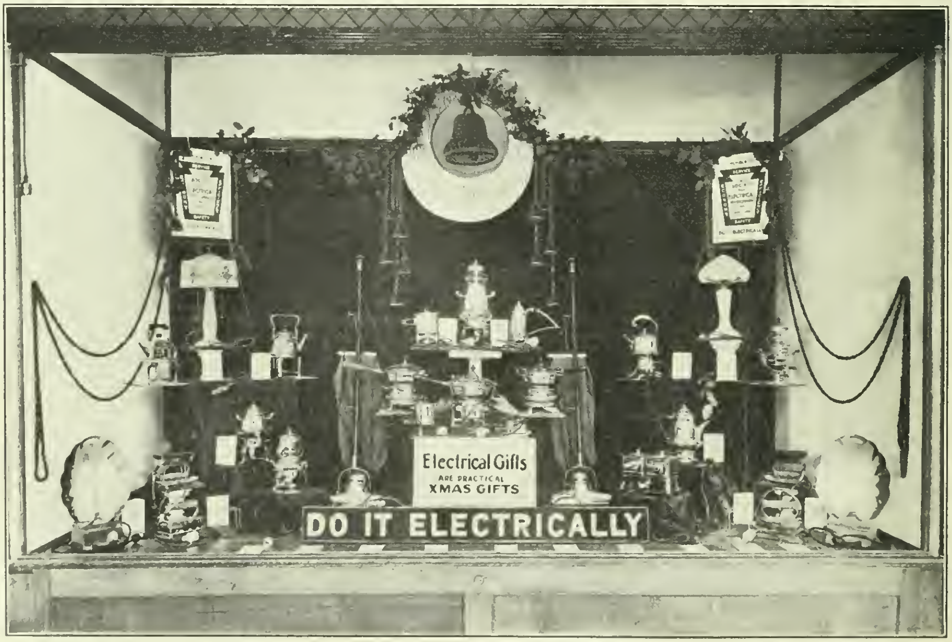
The display that is commonplace will attract only casual observation, and makes the neighboring window, that is attractively made up, appear even better by comparison, a great number of window displays acting only in the capacity of settings for the jewel that is found here and there.

Wherever the attractive window is, there will be found a prosperous merchant who is getting much of his prosperity from his tireless twenty-four-hour salesman, from the sales made from the show-window. He appreciates the results his displays get and keeps its appearance up to a high standard.

By A. J. Edgell, of the Society for Electrical Development.

At night his show window is bright and sparkling and he smiles with pleasure when he sees his competitor's store front dark. He knows that during the evening his good and faithful employee (his show-window) will be on the job making sales for the morrow.

He realizes that people are most susceptible to impressions during the evening hours and he feels that his show-window is a worthy representative of the business. And surely the show-window, the whole store front, is the representative of the business that most people know. The public frequently judges a store from the appearance of the front, and this fact alone would make it worth while keeping the show-windows attractive.



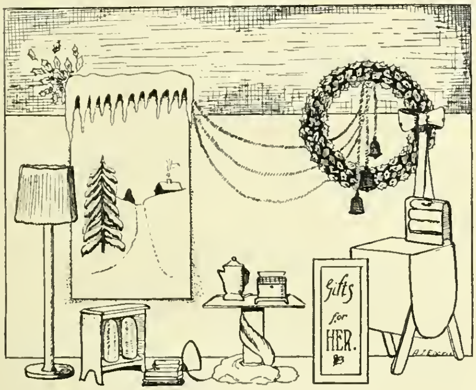
Wherever the attractive window is, there will be found a prosperous merchant.

It is not difficult to arrange displays that will sell merchandise and add to store prestige. With a few pedestals and glass-shelves and some judgment, a fair display can be made by anyone. Care should be taken that the display does not have a "flat" appearance.

The accompanying photo and sketch are suggestions for displays of devices for Christmas gifts. The Christmas season gives an opportunity to introduce many electric appliances to the public, because they are especially suitable for

Christmas gifts of the useful, practical kind.

The photograph illustrates an attractive setting and arrangement for a general Christmas display of devices. The decorative accessories are in the bright holiday colors, red and green. The main background feature consists of a cardboard circle with a large bell in the opening. Over the circle, sprays of artificial holly are attractively arranged. From either side of the circle, pendants of chenille roping or tinsel with small bells are hung. The merchandise is grouped in "units" on the fixtures shown in the small photograph. The fixtures consist of pedestals, glass shelves and wooden boxes. Over them is draped velours of dark green. An electric sign reading "Do It Electrically" and card with the inscription "Electrical Gifts are Practical Gifts" are shown in the fore-



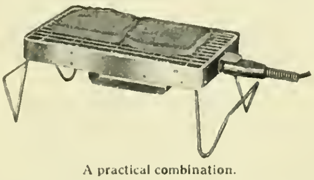
Sketch suggestion for "Gifts for Her."

ground. Descriptive booklets are used to link the display with the advertising literature sent out by the dealer.

The sketch shows an arrangement for a display of "Gifts for Her." A window of this type is an especially good sales-producer as it gives an opportunity to show gifts suitable for "Her" ranging from those for the Baby to those for Grandma. A similar "Gifts for Him" display could also be made. A large wreath made from artificial or real holly or laurel is attached to the background. A large red bow of ribbon or crepe-paper embellishes the wreath. A panel with a winter scene, obtained from a sign-writer has a few sprays of artificial holly attached.

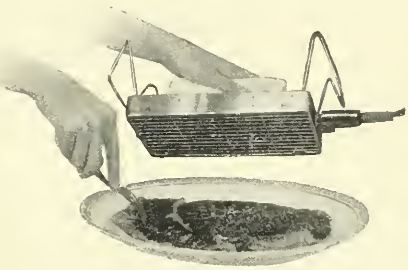
Combined Broiler, Stove and Toaster

An extremely simple, useful and practical electrical device which can be used as a broiler, stove and toaster has just been put on the market by the Canadian General Electric Company. The 1915 Electrical Household Utility, as it is called, has a cooking area 5¾ inches by 9 inches, weighs



A practical combination.

only 1¾ lbs. and can be connected to any convenient electric receptacle. In order to broil you simply invert the grill and place it on the meat which rests on the serving plate or platter. The meat is cooked tender under ideal conditions as there is no flame or combustion. All the juicy tenderness of the meat is retained, as it is quickly seared, while the juices are collected in the platter which is kept warm by the heat from the device. It "saves the gravy." This Utility Grill toasts equally as well as any toaster and



Raise the grill and turn the steak.

can be adapted to all purposes for which a stove is used. Ordinary cooking utensils are used and at the average price for electricity it costs only half-a-cent for 15 minutes' use.

A Mountain of Old Irons

The Victoria Branch of the B. C. Electric Railway Company, Limited, Light and Power Department, held an iron sales campaign recently, covering one month. One feature of the campaign was the acceptance of old irons in part payment of the purchase price of a new iron, fifty cents being the allowance made. The result is that 222 brand new

These all exchanged for "Electrics."

irons are now on the company's lines, in place of the miserable-looking outfit reproduced in the picture herewith.

Apart from the fact that the company's monthly earnings will no doubt be touched up a little, the officials feel that they may have done a few humane acts in bringing in the old irons, particularly a few old gasoline ones. It is estimated that well over 90 per cent. of the company's lighting consumers are now using the handy electric iron.

C. H. Mitchell, consulting engineer of the Water Power Branch, Department of the Interior, Ottawa, during the past summer prepared plans for a hydro-electrical installation at Banff, in the Rockies, at the solicitation of the Canadian Pacific Railway Company. The work will likely be proceeded with during the winter.

The Central Station-Contractor Problem

View-point of a Contractor Engineer—Field of the Central Station Defined—Contracting Soon a Profession

The story of the Central Station is a history of electric lighting in this country together with the enormous kindred business interests which have been created as a result of these operations. It is not necessary for the purpose of this article to enter into a review of this history.

We may, however, with interest and possibly some degree of profit to ourselves look into the factors which were responsible for the creation of such an epoch-making industry, and decide if we may safely deduce conclusions which applied to our daily business life may offer a solution of these problems, which solved will reward with a profit instead of a loss, the operations of many an electrical contractor.

A large number of the more important of the Central Stations in operation to-day owe their existence and support in the earlier struggles which preceded their present power and influence in the electrical field to the policy of the company which was formed to manufacture the Edison lamp and dynamo, newly placed in the market, and to develop commercially the electric lighting industry. To this end lighting companies and plants were established in various parts of the country and financial support furnished, in return for which the lighting company made a close working agreement with the manuafcturing company covering the use and sale of their patented apparatus, lamps, and other supplies. These plants were known and are familiarly styled, even to-day, as Edison, or Licensee Plants.

The undeveloped condition of the country, electrically, at this early period and the intimate relationship between the parent company and the Edison plant, or Central Station, as it soon came to be called, coupled with the active support and dominant business policy which the company consistently dictated to these Edison Plants, resulted, not only in a rapid development of the business, but a well-defined plan or business policy on the part of these plants toward the public.

To-day, scarcely thirty-five years since the inception of this enormous industry, we find this influence still dominant, either directly or by inherited policy, in the operations of many of our Central Stations. Changed, to be sure, but rather because of the great development of the industry and an increased technical knowledge than by any desire to alter a policy which had been handed down for more than a generation and which had been so signally successful.

No Contractors Existed Then

The electrical contractor was not a factor at this early period because his work as a business did not exist. The Companies were the entire electrical industry within themselves. For they built, in a sense, the apparatus and machinery, erected and operated the lighting plant, constructed their lines, and finally, installed the wiring on the premises and supplied the lamps.

The customer paid for the current. Everything else was done for him by the Central Station.

This condition was unique and not duplicated by any other business of the period. In fact to-day among the country's varied industries, there is no other line of business which in its attitude toward the community and other business interests quite parallels the operations of the modern Central Station.

After a time the great expansion, increase in competition, and the consequent necessity for greater economies suggested a separation of the inside construction or wiring end of the business, from the other operations of the plant, and brought the electric wireman or contractor before the public in the industrial life of the community. Of this rapid rise in this branch of the business and the position he has come to occupy in the great electrical development of our busy life, it is not necessary to speak.

I would ask you to note the reasons, however, which led to the creation of his business. To my knowledge, and much though he may be criticized by the Central Station for his occupation of the portion of the electrical field which rightfully belongs to him, I do not recall a single successful challenge of the statement here made concerning the reasons for the setting apart of his work as a separate business.

A Clear Field for Both

The complaints of the electrical contractor with reference to the operations of the Central Station are too well known to require extended repetition here. They might possibly be summed up in a few words by saying that he feels the business of the lighting plant should be chiefly confined to the generation and sale of current, leaving it to him to handle all inside wiring and the sale of supplies. His complaint to-day is that in greater or lesser degree the lighting companies themselves apparently desire to do most or all of these things. That while recognizing the electrical contractor and his business and inviting his co-operation, they seemingly ignore it by tearing down and making it impossible for him to exist. They readily admit the desirability of having the contractor's good will the more successfully to entrench themselves in the good opinion of the public and to keep out demoralizing competition. At the same time the company appears willing to be a party to the destruction of the contractor's business by the sale of apparatus and supplies which of itself profits them nothing, but which is to the contractor a desirable and usually profitable item in his business.

On the other hand and to some degree in defense of their acknowledged attitude of at least partial competition, the Central Stations claim they have been compelled to exploit certain lines in their show rooms since the electrical contractor failed to measure up to the requirements of modern merchandising. The point was made that he was in reality a workman, a mechanic if you please, and not a merchant.

In support of this it was pointed out that he had no adequate stock; that he employed no salesmen in the real sense; and finally, that his place of business partook on the average more of the nature of a warehouse than a modern store. Since under these conditions manifestly he could not properly display and sell these many new modern devices, the Central Station with their large show rooms and sales force were necessarily obliged to do so, else the logical growth and development of their business would be thereby impaired.

Conditions are Changed

We are all familiar with this argument and are bound to admit that a few years ago it was substantially true. Recognizing this, and without attempting to argue the matter as to whether in spite of this admitted shortcoming, it was good business for the Lighting Company to openly antagonize him, the Contractor promptly set about the removal of this objection. Attention was drawn to this criticism on the part of the Central Station. Photographs of many attractive electrical shops were shown and suggestions offered for increas-

ing the attractiveness of these stores from a retail standpoint. Whether or not this campaign was the direct cause, the fact remains that there are to-day hundreds of electrical stores all over the country which in variety of stock and attractiveness of display compare favorably with the best stores in other lines in our cities.

The rapid increase in the number of these modern electrical establishments is not only noteworthy in itself, but especially interesting as showing the immediate response of the electrical contractor to this criticism of the Central Station. It furnishes a correct gauge of his feelings and is a proper index of his willingness, while asking a proper alignment of his business with that of the Central Station, to in turn meet a legitimate criticism more than half way.

And yet it would seem notwithstanding all the effort he had made to work out a satisfactory agreement with the Central Station it comes down to the same proposition in the end and the friction and antagonism remain.

Various attempts have been made to remove this disturbing factor and create a spirit of peace and harmony among all electrical interests. Many suggestions have been made. Plans have been formulated and a spirit of harmony engendered and put into operation. Nevertheless the spectre will not down. The problem is still before us, and is yet to find an answer either final or satisfactory to all interests.

Value of Combined Effort

Recognizing the pulling power and the force of combined effort towards a common end there have been many efforts made to unite the several lines of electrical interests on common ground.

The Co-operative Electrical Development Society is one of the more recent and important of these combinations.

The solution of this problem we are discussing is one the society hopes to help solve. The contractor has been told he should unite in this great movement, one of the more important reasons among others being that thereby is it hoped to bring him into a closer relationship with the Central Station and in a sense help to solve this problem automatically.

While this movement is still comparatively new and while progress is being made there appears to be a feeling of unrest and dissatisfaction among the contractor members and others regarding the real attitude of the Society toward this matter and a feeling of doubt of its ability to accomplish any real good.

The belief of the Central Station engendered of its earlier necessities and successes, and to-day everywhere manifest in its business policy, that it should dictate the policies of the electrical business community even as it dominates them, is now as it has always been, the crux of the entire problem. Studied in the light of present day business combinations and the birth and history of these great modern businesses and carefully considering all the solutions that have been offered, we are bound to conclude that nothing short of an abandonment of its traditional policy will bring about peace and harmony with this new and recognized business which the operation and working out of their own plans brought about.

Working in Harmony

I am entirely aware in suggesting this thought that many harmony plans are being wrought and even carried out, seemingly with success. Contractors and Central Stations in many communities are working in apparent harmony with good results to both.

I have myself taken part and helped bring about such arrangements. That they are not more uniformly adopted however is because even where seemingly most successful they are broken up over night by changes in ownership or by the modern business policy governing the operation of public utility plants. I refer to the joint control of large numbers of plants by one holding company. There are a number of such syndicates operating in this country to-day.

Recently the manager of one of these controlled plants where a very satisfactory harmony plan had been worked out suddenly broke away and began cutting under prices on a certain line of supplies. When approached he expressed the greatest regret but explained he had received instructions from headquarters that his sales of this line of supplies were below the average set for his plant and he must therefore immediately set about remedying this condition. As a result he went back to the old cut price basis.

Cannot Fight Capital

Consider here for a moment the enormous capitalization of many of these plants. Many run up into millions—some in double figures in the millions' column.

Consider further what the combination of a number of such plants means industrially and ponder the feeble means at the disposal of the contractor to combat an adverse policy on the part of such a competitor. Experience has shown that the failure of practically all plans to date has been due directly or indirectly to these policies which the histories of Central Stations have made traditional coupled with the enormous and rapidly increasing capitalization and consequent combination of interests.

What then is there further for the Contractor to do? Where shall be found the answer to a proposition so complex? Shall we longer look for the solution in a co-operation which operates along rigidly fixed and apparently immutable lines? Shall we hope for an individual local solution when the local community, controlled from abroad, has lost its identity?

And yet, in this very local community perhaps shall we find the answer we seek. I have spoken of civic pride and the good of your fellow man. A man who is not stirred by a feeling of interest in his community, who will not give his time freely for its uplift and advancement not only adds nothing to the industrial worth but is a tax on the industrial life and a burden to the citizens.

Price-cutter Condemned

The price-cutter, my friends, comes under this head. He is not merely a vendor of cheap wares but one who strikes at the very heart of successful merchandising. If he injured no one but himself, mention of him here might have been omitted. The losses he causes a legitimate competitor to undergo, by depriving him of the just profit due his industry is taken out of the community and not added to its resources. Too frequently this man demoralizes the trade of his competitors if not his own, and causes loss to others through failures which in turn become a burden to be borne by the community.

He is an economic loss and a failure. Between such a man as this and a price cutting and trade demoralizing Central Station there is little, if any, distinction to be made. Necessity does not demand such a business policy and common sense and the public good forbid it.

May we not then, with confidence, appeal to that public with whom we daily and so intimately associate, to the end that this serious menace to her ultimate commercial success may be removed?

The power of public opinion no man, and certainly no corporation shall successfully withstand. If the fundamental and principal business of a lighting company is the furnishing of current at reasonable rates shall we not best do our duty as citizens and at the same time legitimately serve our business interests by requiring that these companies confine their energies to this and this alone?

If the spirit of the people is to-day strongly adverse to monopoly and the consequent crushing of legitimate enter-

prise and competition will not this operate to make the task correspondingly easier? If it be true that this encroachment by the Central Station on another business already in successful operation, causes an increased expense for current which must necessarily be added to the customer's bill, would not the community profit industrially in much greater degree if the lighting company dropped these side lines, and gave to the community the lower rates which this concentration would make possible?

So to-day, and granting these premises, the truth of which experience has suggested to us, may we not face seriously the proposition of seeking through an aroused public sentiment, the passage of legal measures which shall forever divorce the well defined business of the Central Station from that of the electrical contractor? No intelligent enlightenment of the public concerning many of the operations of the Central Station has ever been seriously attempted by the contractor. I do not for a moment doubt the effect of such a movement. We have all learned that the victories of peace, especially in a business life are to be highly desired and are therefore profitable, but there comes a time when ambition is stultified and progress is arrested by too readily yielding to her allurements.

The Spirit is Willing

Nor would I leave with you the thought that the plan here suggested is merely destructive in character. The broad-gauged attitude of a great many Central Station managers and their very generous support of many of the contractor's plans is too well known to require comment here. It is a fact, however, that some of these very managers operating syndicate plants have themselves suggested that they would welcome such action as would permanently define the policy of their company towards the contractors and leave them unhampered in the working out of their harmony plans in the local field. At present their hands are tied, and the manager acting under definite instructions from the foreign office, is placed in the undesirable position of seemingly breaking faith with the electrical contractor and thereby upsetting plans and creating ill-feeling to the overcoming of which he had previously devoted many hours of hard work. Viewed from this standpoint such a plan as herein presented is in the end truly constructive in character and conducive to peace rather than aggressiveness.

Whether we have come face to face with this condition in the relations between the Central Station and the Contractor as set forth in this presentment and seen in this suggestion a solution of the problem is a matter which must be left to sober thought and calm judgment. If it is to be finally solved it must be approached with an open mind and a spirit of fairness, granting freely the rights of the Central Station and the great part they play in our industrial development while in turn we ask for the electrical contractor the portion that is his due, to the end that he may come into his own and take his proper place in the splendid electrical development which the close of this 20th Century shall have seen brought about.

An Important Contract

The contract for the wiring and for installing the electrical equipment of the new Customs warehouse, Ottawa, has been awarded to the Canada Electric Company, Montreal. The current for lighting and power purposes will be supplied from a sub-station at 2200 volts, and stepped down to 440 volts for power and 110-220 for lighting. The company will supply six transformers—3 of 60 kw. and 3 of 75 kw. The switchboard will be 27 feet long. Three elevators and the ventilating, pumping, and heating systems will be electrically operated, direct current being used for the elevators. The motors will be direct connected, and their supply is not included in the contract. All the telephone wires will be in conduit.

Eliminate the "So-Called" Contractor

Toronto, December 9th, 1914.

The Editor,

Electrical News,

In your issue of December 1, you publish a letter which is being, or rather has been, sent out to the electrical interests in the Province of Ontario by the Hydro-electric Power Commission.

The writer, as an electrical contractor, appreciates very much the favorable comments that you have made on this proposed legislation.

One of the greatest difficulties that the reliable electrical contractor has to contend with is the competition from "so-called" electricians who may maintain an office under their hat—who install electrical work regardless of standard safe methods of construction and create hazards to life and property.

In my opinion legislation along the lines suggested in the letter will be good—will eliminate the so-called contractor who is here to-day and gone to-morrow, and who has no responsibility to the public.

It is perhaps unnecessary to state these facts—everyone familiar with the business is aware of the unsatisfactory conditions—and every one interested will help to remedy the same.

The Electrical Contractors' Association of Toronto is taking this matter up and would be glad to have opinions from electrical contractors giving their ideas of the licensing system—the fees—and in fact any information that they may have regarding licensing systems in other cities.

Communications on this subject should be addressed to George J. Beattie, Secretary, Electrical Contractors' Association, 72 Victoria Street, Toronto, and be sent at once.

It is the intention to call a general meeting of all interested electrical dealers in the Province to take up this question—in the very near future.

Yours very truly,

George J. Beattie,

"The Electric Shop."

Novel Sign for Brick Manufacturer

The Farr Brick Company of Cleveland are firm believers in electrical advertising and recently searched for several weeks in an attempt to locate a suitable roof location on which to place an elaborate electric display. Not getting a prominent space, Mr. Mitchell, manager of the company, opened negotiations with parties owning a piece of vacant property and secured a lease for a number of years. With the aid of the chief designer of an electric sign company of that city, the idea was conceived of building an ornamental wall of brick to be capped with an electric sign. The advertising value of this structure was greatly enhanced by the air of mystery which surrounded the building operations, as nothing of the sort had been attempted before. When complete, the structure will be an ornament to the city, being built in colonial style with the Farr company's new face brick.

The advertising value of this structure has been increased by providing conveniences for the public. Stone benches have been placed and a sanitary drinking fountain, which is to be iced in the summer time. Boxwood trees in ornamental concrete vases beautify the corners and two flag poles 70 ft. in height surmount the corner columns. The electric sign placed at the top of the wall is said to be a marvellous work of art, representing the trade-mark of the company, a winged brick surrounded by an outline of clouds, under which the words, "By Farr the Best" stand out prominently. The wings have the appearance of flying while the clouds in the background seem to be driven by a high wind, preceding a storm.

It is understood that the entire construction cost of this

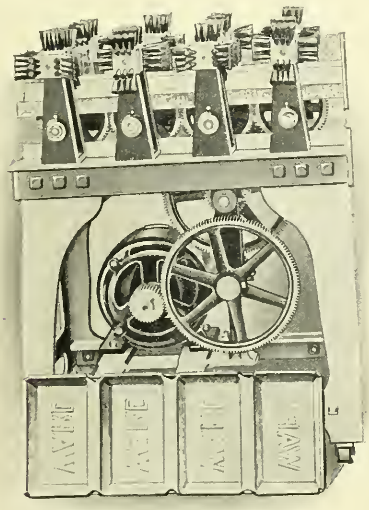
sign is approximately $10,000. The wall is 85 ft. long and 30 ft. high, and the sign is 65 ft. by 30 ft., requiring 1200 10-watt mazda lamps, half of which are equipped with color shades which produce the natural colors desired.

Permanent Canadian Representative

The Morgan Crucible Company, Limited, London and New York, manufacturers of the well-known "Morganite" and "Battersea carbon" brushes, have now a permanent Canadian representative in the person of Mr. Neville G. Johnson. Mr. Johnson will have his headquarters in Toronto, where he will hold himself in readiness to give his personal attention, backed by engineering training and experience, to the interests of all users and manufacturers of electrical machinery at any point in Canada.

Electric Bread Pan Cleaning and Greasing Machine

The illustration below shows a rather unique motor application—a machine patented and manufactured by Gottschalk & Company, Reedsville, Pa., for cleaning and greasing bread pans. By means of a set of stiff brushes the pans are cleaned. Then the opposite set of soft brushes are used for greasing the pans. By cleaning the pans thoroughly before greasing them, the machine eliminates any spots on the



Bread Pan Cleanser and Greaser with Robbins & Myers Motor.

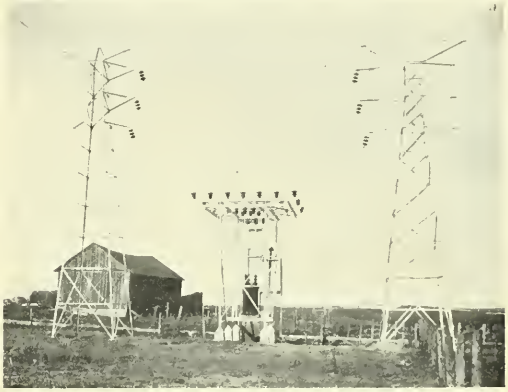
bread. It is also claimed that the pans are greased much more uniformly than where they are greased by hand, with a saving in lard and the elimination of any loaves sticking to the pan. With the machine, one-half pound of lard will grease 2,000 pans.

The machines are equipped with one-quarter and one-half horse-power motors, manufactured by the Robbins & Myers Company, Springfield, Ohio. The outfits are furnished with direct or belt connected motors as desired. The direct connected motors are equipped with back gears operating the brushes at the slow speed of 70 to 80 r.p.m. This means long life for the brushes and prevents any throwing of grease. The motor is mounted on the frame of the machine below the brushes and is protected from crumbs and grease by a metal cover. The outfit is mounted on casters so it can be moved about easily and connected to any lamp socket. The average floor space required is 3 x 5 feet. Outfits can be furnished to suit pans of any shape or size.

66,000-Volt Selector Type Outdoor Steel Tower Sub-station

The marked advance in the design and construction of high tension outdoor steel tower sub-stations during the past year is well illustrated by the installation shown herewith. This station, having an initial capacity of 100 kw. and an ultimate capacity of 1,000 kw., represents the latest development in low cost equipment, and will be a strong factor in selling power from transmission systems.

In order that the three-phase transformer can be energized from either of two sources of power, a standard trans-



66,000 Outdoor Sub-station.

mission tower was set off the right-of-way, and directly opposite a line tower—providing space for the double throw steel tower sub-station between. One set of three-phase line conductors was carried to the right hand tower, thus "splitting" the system, and offering a ready means for carrying taps to the sub-station without crossing of the phase wires. The three-phase switches are of the interlocked selector type, permitting power to be fed from either source without danger of throwing the switch systems together.

Protection is secured by means of choke coils, horn gaps and carbon-tetrachloride fuses on the high tension side, the low tension side being controlled by an automatic 2,200-volt oil switch located in a small house at the base of the sub-station. This house also provides space for meters, spare parts, distribution switches, etc. The transformer rests on a transfer table, insuring ready means for handling units, both during installation and when the station capacity is increased. The 2,200-volt secondary leads are carried under the transformer platform into the cement house, and then pass through conduit to the overhead secondary, or town distribution.

This complete sub-station, known as the "ready-made" type, is the standard type "CAG" form, manufactured by the Delta-Star Electric Company, Chicago, the Canadian sales agents being the Moloney Electric Company of Canada, Limited, of Windsor, Ont.

The plant of the New Denver Power Company, Limited, Nelson district, which was destroyed by fire last July, is again in operation. The service at present is limited, but it is proposed to increase it as soon as business improves.

The Safety First Airbrake Company, Limited, has been incorporated with capital of $300,000 and head office in Victoria, B.C.

A New Protective Relay

By Mr. A. N. Smith

In induction motors the fuses which are inserted in the circuit for protection are practically valueless. This is due to the fact that the fuses are at least 50 per cent. greater than normal full load current. Probably two or three times full load current is the more common fuse capacity. In any case the currents that can flow without blowing the fuse can do considerable damage to the motor, even to the extent of totally burning out the windings. Similarly an induction motor when running will keep running with one fuse blown, taking a proportionately larger current on the still fused phase. If the motor is running over 50 per cent. full load on the still connected phase, and in practically every case this is so, there is a great possibility of a burn out before the other fuses blow. The latter possibility is probably the commonest of all, particularly in the case of star-delta motors which may have heavy fuses (perhaps none) on the starting side, and which, when thrown over to the running side, could continue running.

In view of this the relay described below has been evolved. Its effect is primarily to give an audible or visible signal of a dangerous condition, whether from overload or blown fuses, and to give this signal the instant the dangerous

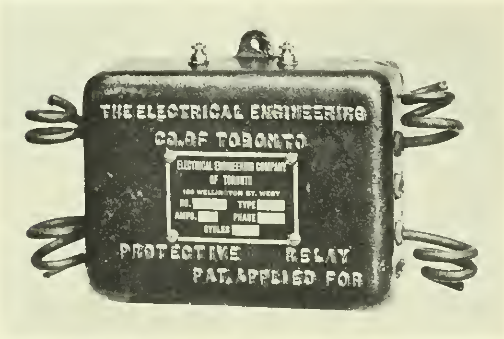


Fig. 1.

condition arises, not some time after, when heat has developed and possibly partially injured the motor. This latter point is where every thermal device fails, as it does not indicate until danger or damage has occurred, whereas in the relay described the indication is given the moment the dangerous condition occurs, and before any heat can develop.

Description

Figs. 1 and 2 show relay ready for installation and Fig. 3 shows arrangements diagrammatically. Three laminated iron limbs, A., B. and C., are arranged with movable keepers, K. Limbs A. and C. have on them a winding inserted directly in the lines supplying motor (in large currents or high voltages series transformers are utilized). E. and F. are two secondary coils for ringing the bell, operating annunciator, or lighting the lamp. Any combination of above can be used. The external circuit of the secondary circuit, however, is only completed when either or both keepers are closed.

Operation

(a) Overload on all phases.—When all phases are more or less equally overloaded at a pre-determined setting, say 25 per cent. overload, both keepers are attracted to the limbs A and C. closing the secondary circuit through the keepers K. at points L. and M. We then have practically a three phase transformer and the secondary voltages in E. and F. add vectorially causing a current which operates the alarms.

(b) Overload on one phase.—Should the overload only exist on one phase, either A. or C. will operate alarms similarly as described in paragraph (a). The relay is so designed that ample energy for the alarms can be supplied by either coils E. or F. alone.

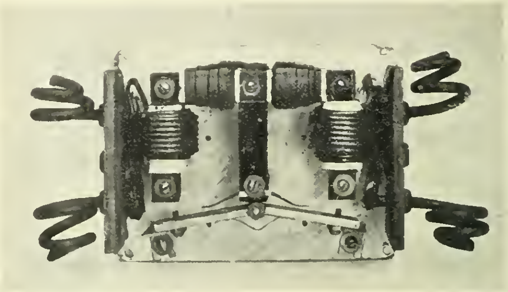


Fig. 2.

(c) Blown fuses.—Should a fuse be blown in either of the lines A. or C. the other limb would operate the moment the current reaches the predetermined setting, this being the dangerous condition. If the current is less than this setting, conditions are not dangerous and relay remains inoperative. If the fuse is blown in the line not introduced into the relay then both limbs A. and C. have to carry the heavier current and when it reaches that for which the relay is set, the keepers operate, thus giving the warning.

We would particularly point out that the relay will re-

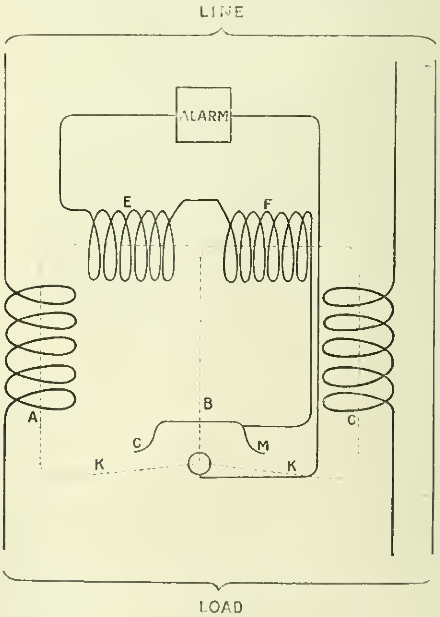


Fig. 3.

set itself, cutting out the alarms, when the current has fallen a predetermined amount, varying from 15 per cent. diminution, down to no-load current, as may be required according to the conditions.

The alarms or signal may be placed near the motor, or

at a remote distance, in, say, the superintendent's office, and since the secondary coils give a voltage of approximately 20 volts, duplicate sets can be arranged, one near the motor, and one a distance away. It should be especially noted there are no dry cells or batteries required, as where one has to rely on such apparatus, the protective value is considerably diminished due to possible troubles and failures of the secondary circuits. The relay as designed is self exciting, needing the simplest wiring with the minimum of attention, and as long as current is flowing there is energy enough to operate the alarms. The relay is exceedingly compact, being contained in a neat wall mounting cast iron case.

This apparatus can be adapted to various uses, a few of which are given below.

(1) As a warning device, visual or audible, of overload or blown fuses.

(2) To convert existing no-volt breaker or starter into combination over-load and no-volt, the no-volt coil circuit being closed through special contacts, which are opened when a dangerous condition arises so tripping the breaker.

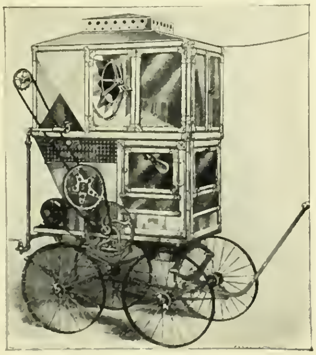
(3) For use on three phase transformers or banks of transformers as per items 1 and 2.

(4) For use in picture theatres where motor-generators are used, preventing the operator from freezing his carbons and so overloading and damaging the motor generator.

Modified designs have been built making the relay suitable for single phase and two phase current as well as that described, which was for three phase current. The whole scheme was designed by the Electrical Engineering Company, 130 Wellington Street West, Toronto, where they are prepared to demonstrate its many valuable features.

A Motor-Driven Peanut Roaster and Corn Popper

Advertising prestige pays in every line of business. Even the peanut and pop corn vendor has found that style is a great profit maker. He is now no longer satisfied with humble equipment, but demands an outfit that will raise him to the level of the great mercantile establishments around which he plies his trade. To meet this demand the Kingery Manufacturing Company, Cincinnati, Ohio, has provided a peanut and pop corn cart "de luxe," glittering in nickel and plate glass illuminated with electric lamps at night, and operated by a Westinghouse Electric small motor. Current is obtained from a plug at the vendor's stand. The motor drives the peanut roaster and the rotary corn popper. Heat is obtained from gas or gasoline. These carts form a small but attractive load for central stations, as connections are easily installed and there is no meter to read, flat rates being usually charged. The cost of the cart is reasonable while payments can be made on easy terms.



The scientific pop-corn vendor.

Encouraging Local Industries

In an effort to encourage and support, as far as possible, local industries in Victoria and vicinity, a Fair was held in the Drill Hall on 22nd, 23rd and 24th of October, and was participated in by practically all of the manufacturers and merchants in the community. This affair proved a great success.

Section of Electrical display at Victoria Fair

The accompanying photograph shows part of the Electrical display arranged for on the occasion. This exhibit was the result of co-operation between the B. C. Electric Railway Company and the local electrical dealers and formed a very interesting feature during the Fair. Demonstrations of all appliances were carried out, and between six and seven thousand people attended on the 3 days during which the exhibition was open. On the last day about 300 ladies were served with refreshments prepared on electric ranges.

Industrial Controller Company

The name of the Independent Electric Manufacturing Company, has been officially changed to the Industrial Controller Company. The increasing use of the company's apparatus with the industrial concerns throughout the country, and for industrial purposes, has made it seem advisable to change the name of the company so that it might better describe the product. There will be no change in the personnel of the company, and the trade mark, I-C, will remain the same.

Controlled Boat in 28 Mile Radius

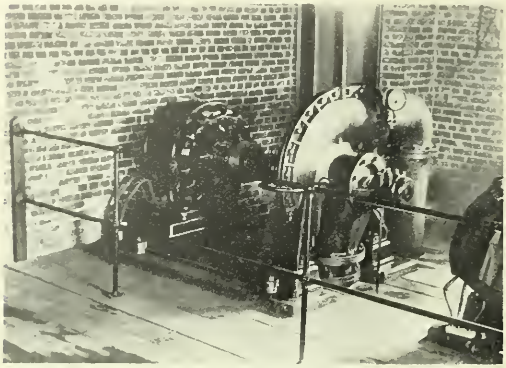
John Hays Hammond, son of the mining engineer, has invented a radio boat which, he says, will revolutionize naval warfare. A successful test was made November 21, when the boat, named the Natalie, unmanned, was set loose near Graves light, just outside Boston harbor. Working his wireless station at Gloucester, twenty-eight miles away, Mr. Hammond steered the boat at will.

Use for Reducing Taxes

A movement headed by the city of Berlin, which is receiving a certain amount of support in other towns in the hydro area, is being made to influence the local legislature to so amend the Public Utilities Act that hydro-electric surpluses may be devoted towards a reduction of the general tax rate.

2000 Gal. Motor-driven Pump

The pump shown in the accompanying photograph was supplied by Boving & Company of Canada, Limited, to the municipality of Burnaby, B.C. The capacity is 2,000 gallons per minute, against an 80 ft. head. The pump is direct connected to a 75 h.p. Westinghouse, 3-phase, 60 cycle, 220 volt

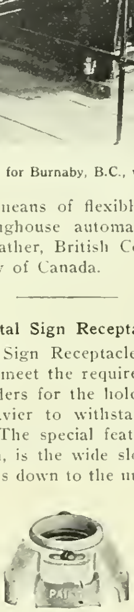


New pump for Burnaby, B.C., waterworks.

induction motor, by means of flexible coupling. Motor is controlled by Westinghouse automatic starter. Installed complete by R. F. Mather, British Columbia representative of Boving & Company of Canada.

Metal Sign Receptacle

Paiste No. 61777 Sign Receptacle, illustrated herewith, has been designed to meet the requirements of a large sign company. The shoulders for the holding screws have been made very much heavier to withstand all the wrenching which they receive. The special feature of this receptacle, outside of its strength, is the wide slots and the guide that lead the holding screws down to the nut. This makes it very



easy to put the holding screws in, and saves a great deal of workman's time. The nuts for the holding screws are fastened in place by clips so that they cannot get out of position. The centre contact is of phosphor bronze as in all Paiste sockets and receptacles. This receptacle is sold by the Hart & Hegeman Manufacturing Company, Hartford, Conn., and in Canada by the Canadian General Electric Company.

Shaydolite

"Shaydolite" is an English lacquer of great value in coloring glass used in electric fixtures and decorations. It is made in various colors, one characteristic being that it does not interfere with the transparent qualities of the glass. To color lamps, they have simply to be dipped into a bowl of Shaydolite until submerged, and dried with the current turned on. The lacquer is used by the Canadian Government and Canadian railways and has also been supplied to the Royal Palaces and the British Navy for decorative purposes. The Spielmann Agencies, Limited, of Montreal, are the Canadian agents.

Larger Quarters in Walkerville

The Detroit Fuse and Manufacturing Company announce that they have been forced to find a more suitable location giving them much more space than they had available in Windsor, and that they have now located in Walkerville, Ont., where they will carry a complete line of the Detroit Arcless fuses, switches and motor starters. Mr. Plate who has been connected with the main office of this company for some time will have complete charge of the Windsor branch

U.S. Electrics in England

The Baker Motor Vehicle Company, Cleveland, O., have recently closed negotiations with the Wolseley Motors, Limited, to represent it in England. The new agents expect to operate particularly with trucks as the conditions in England at this time are said to be especially favorable for this type of vehicle. They now have in operation a number of Baker trucks as demonstrators and will begin at once to handle their sale.

The British Canadian Engineering & Supply Company, Limited, have just set in operation an electric lighting plant in the town of Broadview, Sask., which consists of a 72 brake h.p. Ruston Proctor suction gas engine and producer plant; a 50 kw. Westinghouse generator, three-phase, 60-cycle, 2,300 volts complete with necessary exciter and two panel switchboard; also regulator transformer for series tungsten street lighting system. The above company installed the whole equipment including poles, pole line, transformers and meters.

Trade Publications

Gas Electric Cars—Bulletin 44300, issued by the Canadian General Electric Company, describing and illustrating gas electric motor cars and locomotives.

Station Devices—Folder issued by the General Devices & Fittings Company, Chicago, illustrating profusely and briefly describing, their lines of high and low tension station devices.

Section Insulators—Folder distributed by the Ohio Brass Company, Mansfield, Ohio, illustrating three features of the O-B Type C section insulator that saves linemen's time and interruption of service.

Railway Apparatus—Treatise issued by the Canadian General Electric Company, entitled "Modern Electric Railway Apparatus." A number of recent noteworthy installations are illustrated and described.

Street Lighting—Hand booklet issued by the Canadian General Electric Company, illustrating and describing the attractive lighting of a number of prominent business streets at different points on the North American continent.

Cable End Bells—Bulletin number 102, being distributed by the Electrical Engineers Equipment Company, of Chicago, describing and illustrating cable end bells, all voltages and shapes for inside, outside and underground service. The same company have issued bulletin 103, describing and illustrating Bus Bar Supports able to carry various forms of buses. This bulletin is splendidly illustrated in two colors.

Personal

Colonel J. G. Monahan, A.I.E.E., late western manager of Ferranti, Limited, with headquarters at Winnipeg, and Miss M. T. Grierson, of Toronto, were married at Los Angeles, Cal., November 24, where the bride has been visiting. Colonel Monahan has a host of friends among the business men of Winnipeg, who gave him a farewell dinner at the Fort Garry when he left for California last month.

Current News and Notes

Chilliwack, B.C.

The annual report of the Chilliwack Telephone Company, Limited, showed gross earnings, $15,871; expenses, $8,271; net earnings, $7,600. After writing off for bad debts and depreciation $3,860 remained for dividends which on a capital of $45,580 is approximately 8 per cent. A 7 per cent. dividend was declared.

Dundas, Ont.

A contract for the erection of the local sub-station has been let to contractor Thos. Woods.

Fort Frances, Ont.

The appeal of the Ontario and Minnesota Power Company against a recent decision of Mr. Justice Latchford re property assessment of this company in Fort Frances, has been dismissed by the Court of Appeal. The company deem themselves over assessed and have refused to pay the full amount of their taxes.

Fort George, B.C.

The electric light system at this point was recently destroyed by fire. It is expected that the Northern Interior Power Company will, in a few days, be in a position to provide a temporary supply of light.

Hamilton, Ont.

The Hydro-electric Commission will advertise their list of electric household goods, between now and Christmas, according to a recent decision of the Board of Control.

The Bell Telephone Company and the Board of Control have agreed upon the terms by which the company shall be given another year of exclusive franchise in this city. It is understood that the company agrees to pay $5,000 for the privilege.

The Hydro Power Commission will purchase fifty badges of a special design for employees of the department who have to visit private houses and places of business for the purpose of reading meters and inspecting wiring. This will protect power and light users against men other than employees of the commission gaining access to private buildings.

Lambeth, Ont.

A by-law was recently passed authorizing the Village Council to spend $4,000 on an electric distributing system.

London, Ont.

The Board of Control of the city of London has recommended to the City Council that a request be made to the Dominion Railway Board for an order to have all wires placed underground in the down-town section of the city.

Montreal, Que.

The Montreal Light, Heat and Power Company are about to organize a section of the Home Guard, supplying the arms and accoutrements.

The Canadian Hart Accumulator Company, Limited, have taken offices at 301 Guarantee Trust Building, Montreal. Mr. A. H. Box is the secretary.

It is understood the City of Quebec will ask the Provincial Legislature for power to raise a loan to purchase the plant of the Dorchester Electric Company, Quebec, the price being stated at one million dollars. It is said however that in the meantime negotiations are proceeding between the company and the Shawinigan Water and Power Company for the acquisition of the Dorchester company by the Shawinigan.

Mount Brydges, Ont.

On November 23rd the ratepayers voted by 73 to 3 in favor of closing a contract with the Hydro-electric Power Commission of Ontario.

Niagara Falls, Ont.

Contracts have been awarded for the equipment necessary in the installation of a modern street lighting system. Standards are being supplied by the Pollard Manufacturing Company. The Northern Electric Company will supply the cables, the Westinghouse Company, two regulators and other auxiliary equipment.

Newmarket, Ont.

The Council has decided to submit a by-law on January 4th, authorizing an expenditure of $15,000 on the construction of a sub-station to be used in connection with a supply of power to be received through the Hydro-electric Power Commission of Ontario.

Orillia, Ont.

The Council have requested the commission to install some fifty 100-watt tungsten lamps, distributing them on both sides of the main street from Andrew Street to the lake. The quesion of making use of the poles of the Bell Telephone Company will be taken up with that company.

Ottawa, Ont.

The McDonald Hydro-electric Heating Company, Limited, have been granted a license.

Peterborough, Ont.

The Canadian General Electric Company have undertaken to construct buildings and install machinery to an estimated cost of $150,000, in return for which the city agree to take care of the rental of about three miles of the unused Chemong section of the Grand Trunk Railway line, which the Canadian General Electric Company will use for testing purposes for the electric locomotives they propose to manufacture. The expenditure incurred by the city will be approximately $115 a year, in return for which they will receive one of the most promising industries in the electrical trade to-day.

Renfrew, Ont.

The Renfrew Electric Manufacturing Company has finished its first year with a satisfactory balance sheet. A dividend of eight per cent. will be paid and the balance carried to reserve account. Thomas A. Lowe was re-elected president and Dr. Connelly, W. T. Guest and J. A. Jamieson were again chosen directors.

Saskatoon, Sask.

It is expected that the city's electric light and power and waterworks departments will show very ample surpluses for the first ten months of the present year, and that figures to be submitted shortly to the council will bring about marked reductions in rates. During last month, for instance, the electric light department showed a surplus of over $6,000, while, for the entire year, it is estimated that the waterworks will yield a profit of not less than $14,000.

Smithville, Ont.

A largely attended meeting of the ratepayers of the new-

ly incorporated village of Smithville, was held recently, and it was decided to request the Hydro-electric Power Commission of Ontario to prepare an estimate of the cost of a supply of light to the village and surrounding township.

St. Catharines, Ont.

The St. Catharines Hydro Commission will purchase a pulmotor for use in case of accident through any employee or citizen coming in contact with electric wires.

St. Marys, Ont.

The Water, Light and Heat Commission contemplate extending the electric lighting system a mile and a half along Widder Street.

Estimates are being prepared on the cost of giving a service to the village of Rannock where it is believed there is a market for fifteen or twenty horse-power.

Strathroy, Ont.

Hydro-electric power was turned on in this town on Monday evening, November 30th.

Sydney, N.S.

From Sydney, N.S., comes the gratifying report that two thousand men are employed at the Dominion Steel Company's plant. This is more than two-thirds of the full force in the busiest times. Rod, bar, nail, wire and billet mills are working full time, double shift, and a ten thousand ton order of rails is being rolled. Four shipments of wire have been sent to England, and other shipments will follow as soon as possible.

Toronto, Ont.

A number of new lamps are being installed around the Parliament Buildings. These consist of nitrogen filled tungstens on attractive pillars.

It is rumored that negotiations are under way for the merging of the telegraph system of the Great North Western Telegraph Company and the Canadian Northern Railway Company.

The Toronto-Hamilton Highways Commission, of which Mr. George Gooderham, of Toronto, is Chairman, have under consideration draft plans for a high level bridge at Carroll's Point, Hamilton, Ont. The plans were prepared by the Hamilton Bridge Company and the estimated cost is $327,000. The proposed undertaking will be financed by the city of Hamilton and the County of Wentworth.

At a recent meeting of the Tramways Association of Great Britain, a suggestion was made regarding the introduction of rubber or some other silent material for street car tires, with the object of eliminating noise and vibration.

Vancouver, B.C.

The Farmers' Telephone Company, Limited, of Steveston, Lulu Island, is in the hands of a liquidator who will on and after December 10th proceed to distribute such assets as may then be available.

The municipal council of Point Grey recently amended its electric wiring by-law so as to conform with the requirements of the city of Vancouver, where the rules are exceedingly stringent.

The Yellowhead Light & Power Company, Limited, with offices at 415 Winch Building, Vancouver, has made application to the provincial recorder at Barkersville, Cariboo District, for a license to store water for power purposes. The proposed point of diversion is approximately three miles by river from the junction of the Moose and Fraser rivers, at the foot of the first falls. It is proposed to erect four dams for holding purposes, the estimated capacity of the reservoirs in acre feet and approximate area of land to be flooded being as follows: Reservoir above Dam No. 1, 600 acres, 24,000 acre feet; reservoir, Dam No. 2, 500 acres, 20,000 acre feet; reservoir Dam No. 3, 625 acres, 14,000 acre feet; reservoir Dam No. 4, 4,340 acres, 7,000 acre feet.

Victoria, B.C.

The fire wardens' committee of the City Council has recommended the installation of a larger capacity fire alarm system. This system would incur a cost of about $10,000.

Wallaceburg, Ont.

Work has commenced on the erection of the Wallaceburg hydro-electric sub-station. It will be located on King Street. Some work has also been done on the erection of poles.

Waterford, Ont.

Work has started on a small hydro-electric sub-station building being erected at this point by the contracting firm of Wells and Gray.

Pipe Taplet Tap Block

A new tap block has been designed for Paiste pipe taplets, which will fit all way down in the taplet, although there is plenty of space under it for a third wire. This tap block does away with all soldering, either of branch wires to the main wire, or of tap wires for fittings. The main wires are bared for ⅜ of an inch, and fastened to the binding screws of the tap block. The tap or branch wires are fastened to the connecting binding screws. These tap blocks are approved, and make a very safe joint without any risk of short circuiting. One size fits both ½-in. and ¾-in. pipe taplets.

The Hart & Hegeman Manufacturing Company are sole selling agents for Paiste fittings which are handled in Canada by the Canadian General Electric Company.